# STATUS OF MINERAL RESOURCE INFORMATION FOR THE KOOTENAI AND COEUR D'ALENE INDIAN RESERVATIONS, IDAHO

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## SUMMARY AND CONCLUSIONS

The Kootenai Indian lands have no known mineral deposits; however, the nearby Selkirk and Purcell mountains have a production history of lead, zinc, silver, and gold. Hall Mountain has a potentially economic thorium deposit; uranium exploration in the area has recently increased. Peat deposits in the Kootenai River Valley may extend into Indian lands. Most of the peat at or near the surface is admixed with sand and silt and is valuable farm land.

Patented claims in the northeast part of the Coeur d'Alene Indian Reservation have had considerable lead, zinc, and silver development. The area northeast of the St. Joe River may have potential for lead-zinc-silver deposits. Iron deposits and prospects occur in the southern part of the reservation; two of these deposits, on non-Indian land, have records of production. Nonmetallic minerals offer a good development potential. Near Tensed, on private land, clay is currently being mined; similar deposits might be found on Indian lands. Indian lands shale deposits are being studied for use in building brick. Crushed rock, building stone, and cobbles may also be marketable. The reservation's extensive basalt deposits may be suitable for use in manufacturing insulation and polymer reinforcement fibers, or possibly fused-cast linings, when the technology develops.

## INTRODUCTION

### General

This report on the Kootenai and Coeur d'Alene Indian Reservations was prepared for the Bureau of Indian Affairs (BIA) by the U.S. Bureau of Mines and the U.S. Geological Survey under an agreement to compile and summarize available information on the geology, mineral resources, and economic potential of certain Indian lands. It is based on source material in published and unpublished reports and maps, thesis work, resource computer files of the U.S. Bureau of Mines and the U.S. Geological Survey, and discussions with knowledgeable individuals.

### Acknowledgments

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## KOOTENAI INDIAN RESERVATION

### Geography

Kootenai Indian lands occupy 2,396 acres scattered chiefly along the Kootenai River Valley between Bonners Ferry and Porthill, Boundary County, Idaho (Figure 1). Tribal headquarters for the 65 members is about 3 miles west of Bonners

Ferry. BIA headquarters is at Lapwai, near Lewiston, Idaho.

Kootenai Indian lands are accessible primarily from U.S. Highway 95, the main north-south arterial from Coeur d'Alene, Idaho, to British Columbia. The Burlington Northern Railway passes through Bonners Ferry, and a branch line, later abandoned, formerly extended from Bonners Ferry north along the east side of the Kootenai River Valley to the Canadian border.

## Physiography

The Kootenai River Valley is part of the Purcell Trench, a long glaciated valley that extends south from British Columbia past Bonners Ferry and on toward Coeur d'Alene. The flat-bottomed valley floor actually is in part a lake bed from an ancient lake, the remnant of which is present Kootenai Lake in British Columbia. The gradient along the Kootenai River, between Bonners Ferry and the Canadian border, a distance of about 25 miles, is only about four inches per mile.

The flat-bottomed Kootenai River Valley is two to three miles wide in the vicinity of the Indian lands. Formerly, most of the valley was swampland that was flooded annually by spring runoff of the meandering Kootenai River. Beginning in the 1920's, the valley land began to be reclaimed through construction of dikes along the river banks. Reclamation lead to development of rich farm lands in the valley.

Adjacent to and west of the Kootenai River Valley is the Selkirk Range, which rises to a maximum elevation of 5,900 feet above the valley floor. The steep eastern flanks of the range have been scoured and polished by glaciers that moved along the Purcell Trench from British Columbia south to the vicinity of Coeur d'Alene, Idaho. East of the valley and 480 feet higher in elevation is a prominent topographic bench, part of the floor of the Purcell Trench. The Purcell Range rises east of the bench.

Numerous small streams drain into the Kootenai River from the Selkirk and Purcell Ranges (Figure 1).

## Geology

The geologic setting of the Kootenai tribal lands is shown on Figure 2. Tribal headquarters buildings, about 3 miles west of Bonners Ferry, are on a small hill of granodiorite that rises 208 feet above the floor of the Kootenai Valley. All other tribal lands are underlain by valley alluvium or glacial gravel and debris. Other rock types that either underlie the alluvium and glacial debris or are readily visible in nearby mountains are described briefly in following sections.

### Metamorphic Rocks of Uncertain Age

West of the tribal headquarters, extending along the eastern base of the Selkirk Range, is a belt of metamorphosed sedimentary rocks of uncertain age. The metamorphosed rocks include schist, quartzite, amphibolite, and paragneiss. The rocks probably are members of the Prichard Formation of Precambrian age; however, intensive metamorphism and shearing have changed them and made accurate identification of them difficult. Similar rocks are not known on the east side of the Kootenai River Valley.

### Prichard Formation and Purcell Sills and Dikes

The Prichard Formation consists of argillite, siltite, and quartzite of Precambrian age. These rocks are intruded by Precambrian sills and dikes of metadiorite and metagabbro that are known locally as the Moyie sills but elsewhere as the Purcell sills. The intrusive sills are not differentiated on Figure 2.

Prichard Formation and Purcell sills form most of the Purcell Range and probably underlie most the glacial debris that forms the bench along the eastern side of the Kootenai River Valley.

### Granodiorite

Granodiorite forms the hill on which Kootenai tribal headquarters buildings are constructed. The rock is part of a larger mass of plutonic rocks that crops out in the vicinity of Brush Lake, along the eastern side of the Kootenai River Valley near Copeland and along Highway 95 to the east. The rock is chiefly hornblende-biotite granodiorite and at some outcrops it is characterized by phenocrysts of pink orthoclase as much as three inches in length. The granodiorite outcrops are resistant to erosion and tend to form hills and bluffs that stand above the younger and less resistant alluvium.

Previous writers (Kirkham and Ellis, 1924; Kiilsgaard, 1949) considered that granodiorite to be part of the Nelson batholith, which is of Cretaceous age. Miller and Engels (1975), with a series of potassium-argon analyses of the granodiorite, have confirmed it as Cretaceous.

### Undifferentiated Granitic Rocks of the Selkirk Crest

West of the Kootenai River Valley, the crest of the Selkirk Range is composed chiefly of granitic rocks of varying composition, but in which the minerals biotite and muscovite are dominant, whereas hornblende is deficient. Previously, these rocks had been considered equivalent to the granodiorite east of the Kootenai River but Miller and Engels (1975) found the Selkirk rocks to differ in composition and to be younger than the granodiorite east of the Kootenai River. Glacially--polished outcrops of the two-mica granitic rocks are conspicuous along the eastern flanks of the Selkirk Range and are visible from the Kootenai Indian Reservation headquarters.

### Quaternary Glacial Debris and Alluvium

Except for a few small protruding hills of granodiorite and Prichard Formation and Purcell sills, the Kootenai River Valley and adjoining benchland is underlain by sand, gravel, and boulder debris, which has resulted from Pleistocene glaciation and Recent erosion.

Boulder-strewn till and glacial moraines of Pleistocene age are common in higher valleys that drain into the Kootenai Valley (Figure 2). Sand, clay, and gravel compose the benchland along the east side of the Kootenai River Valley and the higher valley that extends toward Sandpoint. The alluvial material is a product of Pleistocene glaciers and most of it was deposited in a lake or lakes associated with the glaciers.

The floor of the Kootenai River Valley consists of fine silts, sand, and peat. The valley-floor alluvium, in part of Recent age, originally was deposited in ancestral Kootenai lake or in marshes that developed as the water level of the lake was lowered. The fine, alluvial sediment and decomposed organic debris make fine-textured soil and rich farm land.

## Structure

The major geologic structure in the Kootenai River Valley is postulated to be a fault that extends along the western side of the valley and on to the south along Deep Creek (Figure 2). Throughout the valley, the fault is concealed by alluvium or glacial debris.

A large amount of movement is believed to have occurred along the fault. Evidence for major movement includes: (1) granitic rocks on each side of the valley are different; (2) Precambrian rocks on the west side of the valley are more intensely metamorphosed than those on the east side; and (3) truncated ridges along the eastern slopes of the Selkirk Range are indicative of a major fault scarp.

Neither the major fault or other faults appear to have had any effect on the Indian lands.

## Economic Geology

There are no known deposits of commercial minerals on the Kootenai Indian Reservation, nor are any likely to be found there.

Most of the Indian lands are on valley bottom alluvium, which is of unknown thickness but likely to be more than 100 feet. No mineral deposits of commercial value are known to occur in the alluvium anywhere in the Kootenai Valley. Peat, which is decomposed organic material and which is used as a soil conditioner and in some parts of the world as fuel, occurs in the valley-bottom alluvium but known deposits are thin, discontinuous and admixed with silt and sand. Those at or near the surface probably are more valuable as farm land than for contained peat.

Radioactive minerals, gold and heavy minerals commonly are concentrated in alluvium but such deposits are not known in Boundary County, nor in the Purcell Trench to the north in British Columbia, the site from which most of the glacial debris came. The chance of finding commercial concentrations of such heavy minerals on the Indian land is remote.

Mineralized veins crop out in the Purcell Range east of the Kootenai River Valley. The most productive deposit has been the Silver Crescent mine, which consists of silver-lead-zinc veins in granodiorite. Other mineralized veins of the range are chiefly in the Prichard Formation, commonly at or near the contact with intrusive Purcell sills. At the Montgomery mine, on the west side of Hall Mountain and about two miles east of the northernmost tract of Indian land, nickel minerals occur in the basal part of a Purcell sill.

The largest occurrence of mineralized veins, deposits that are likely to be mined in the future, are thorium-rich veins in the Prichard Formation about four miles east of Porthill on the west side of Hall Mountain. These thorium deposits are only about two miles from the northernmost tract of Indian land. Judging from the geologic environment of the Hall Mountain deposits and the strike of the veins as described by Staatz (1972), there is little likelihood of similar deposits being found beneath the gravel on the nearby Indian land.

Sand and gravel could be quarried from Indian land on the bench east and south of the Kootenai River but sand and gravel quarries are plentiful and more accessible in other parts of Boundary County.

## Metallic Mineral Resources

A number of mines and prospects, some of which are close to Indian lands, are scattered throughout the Purcell Mountains (Figure 3) and are described in Table 1. Boundary County includes the Moyie-Yaak and Porthill mining districts, which are separated by the Kootenai River. The area is known for gold, silver, copper, lead, zinc, nickel, molybdenum, tungsten, uranium, and thorium. Four mines yielded significant amounts of silver-lead, and lesser amounts of gold and zinc. The Idaho Continental Mine, about 19 miles southwest of Porthill, yielded 850,000 ounces of silver, and 44 million pounds of lead between 1915 and 1924 (Kirkham and Ellis, 1926, p. 56). Significant amounts of gold, silver, lead, and zinc came from three mines in the area: the Regal (Silver Crescent) and Cynide, which are about 15 and 22 miles southeast of Porthill, and the Idamont, which is about 14 miles southeast of Bonners Ferry. No mines operate in these districts at present.

## Nonmetallic Mineral Resources

### Sand and Gravel

Sand, gravel, and borrow deposits are scattered along the Kootenai River Valley, near Bonners Ferry, and near tributaries to Deep Creek. Several county and privately owned sand and gravel pits currently are operated near Bonners Ferry (Figure 4), whereas others appear to be used on as-needed basis. No sand and gravel pits are reported on Indian lands, but good deposits may be present.

### Peat

General.--Peat consists of light-tan to black, partly decayed vegetable matter, minerals, and water (Cameron, 1973, p. 505). Peat forms in marshes, swamps, or similar wet areas. Its formation depends on profuse plant growth and its accumulation without complete decomposition. Climate, topography, and fluctuations of the water table are the chief factors affecting peat accumulation.

The U.S. Bureau of Mines classifies peat into three general categories: moss peat, reed-sedge peat, and peat humus. This classification mainly describes the vegetation that formed the peat. A more useful classification is based on its water--holding capacity, organic, fiber, ash content, and acidity (Cameron, 1970, p. A7-A10). The American Society for Testing Materials (ASTM) published standard methods of testing each of these properties (Cameron, 1975, p. C3). The Cooperative Extension Service at Michigan State University (Lucas and others, 1966) published a user's guide for peat based upon the above characteristics.

Today peat is used mostly in horticulture and agriculture; however, in the United States, interest is increasing in its use as an energy source, either by direct combustion or gasification. In eastern North Carolina and northern Minnesota, large reserves of peat are being tested for their suitabilities for fuel in electric power generation and for gasification (Carter, 1978, p. 33-34). Ireland, a major user of peat as fuel, derived one-third of its energy from it in 1975 (Boffey, 1975, p. 1070). In addition to using peat in energy production, it can also be an important source of raw materials for the chemical industry. According to Fuchsman (1978, p. 6-7, 118-119), the products obtainable would be similar to those extracted from coal and petroleum and include:

-the bitumens, which include waxes and resins. The U.S.S.R. has produced peat wax for years, and Finland is seriously considering such production.

-carbohydrates, which can be used to cultivate high protein-producing yeasts for livestock feed.

-carbon, which includes peat coke and activated carbon. Finland currently has a peat coke industry.

Kootenai River Valley Deposits.--Extensive peat deposits (mainly reed-sedge) occur in the Kootenai River Valley (Savage, 1964, p. 145). No detailed evaluation has been made, but a soil map of Boundary County (Weisel and Chugg, 1976) outlines three soil types that contain peat (Figure 5). Pywell muck, a decomposed peat, is at least 5 feet thick, and may be a potential Valley resource, but it is not known on Indian lands. The DeVoignes-Ritz soil is as much as 9 inches thick and is made up of varying amounts of decomposed peat. The DeVoignes-Ritz soil may contain areas of thick peat accumulations. The Pywell--DeVoigness complex, a mixture of the first two soil types, occurs on and near Indian lands in secs. 7, 18, 19, T. 62 R., R. 1 E., sec. 12, T. 62 N., R. 1 W., and in one small area southwest of Naples, several miles south of Indian land.

## Energy Resources

### Uranium

The area comprising the U.S. Geological Survey Sandpoint 2º topographic map, including the Kootenai River Valley and the Purcell and Selkirk Mountains, is currently being investigated for uranium potential by the Department of Energy (DOE). This is part of the National Uranium Resource Evaluation (NURE) program, which includes geological, geophysical, and geochemical surveys. These studies will assess the magnitude and distribution of uranium resources, and determine favorable areas for further exploration in the United States. Completed fieldwork includes:

(1) Airborne radiometric and magnetic surveys.

(2) Groundwater, hydrogeochemistry, and stream sediment evaluation. Announcements of released reports can be obtained by writing:

Peter Mygatt
Department of Energy
P. O. Box 2567
Grand Junction, CO 81501

Uranium exploration in Boundary County has increased recently, leading to the location of 760 uranium claims (Bendix Field Engineering Corp., 1978).

The Dehlbom, Naples, and the "U" group are the only known uranium prospects in the Kootenai River Valley (Table 2 and Figure 6). The Dehlbom and "U" group prospects are within 2 miles of Indian lands.

Samples of intrusive rocks from the nearby Selkirk and Purcell Mountains (Figure 6) contain uranium in amounts below the established anomalous value of 10 ppm (Castor, and others, 1971, p. 15). The forthcoming DOE reports on stream sediment and hydrogeochemical sampling and geophysical surveys may define the uranium potential of this area.

## Peat-Lignite-Uranium Association

Quaternary peat deposits, containing 50 ppm uranium or greater, are known in California, Colorado, Utah, New Mexico, and Florida (Vine, 1962, p. 126-129; Gabelman, 1955, p. 312). They also occur in Australia, the Soviet Union, and Sweden (Levinson, 1974, p. 448; Brooks, 1972, p. 186-188). The California deposit in northern Fresno County has as much as 0.7 percent uranium. Uraniferous peat has not been reported in Idaho, but uraniferous lignites do occur in Payette, Twin Falls, Cassia, and Bonneville Counties (Cook, 1957, p. 2; Vine and Moore, 1952, p. 1). Uranium in lignite also has been reported in most western states and has been mined in North and South Dakota (Averitt, 1974, p. 83; Benson, and others, 1959; King and Young, 1959; Mitchell, 1965).

The association of peat and uranium is being presently studied in detail (Cameron, personal commun., 1978); Usik (Brooks, 1972, p. 187-188) has suggested five steps for detailed investigation of peat bogs. This association warrants further investigation as part of any resource evaluation of Indian lands.

## Thorium

Domestic consumption of thorium (as $ThO_2$ equivalent) in 1977 was about 45 tons, 35 tons of which were consumed in non-energy uses. About ten tons of thorium were used in two nuclear reactors as a fertile material combined with uranium to produce fissionable $U_{233}$. Bred from thorium and diluted with $U_{238}$, $U_{233}$ can be used as nuclear reactor fuel that would be unsuitable for use in nuclear weapons (Kahn, 1978, p. 133). The DOE has funded the U.S. Geological Survey to enlarge and redirect its thorium program. Reassessment of high-grade thorium reserves in selected districts of the United States (Finch, 1978, p. 49) is the objective of the first phase of this program.

Two localities in Idaho contain vein deposits of thorite worthy of mention. One is at Lemhi Pass near the Idaho-Montana border in southeast Idaho. This deposit has yielded no thorium, but has been the subject of considerable study (Staatz, 1971, 1972b; Sharp and others, 1968; Anderson, 1960; Austin and others, 1970). The other deposits are on Hall Mountain in northern Boundary County (see next section). With increasing interest in thorium as a fuel for nuclear reactors, the economics of these deposits may change sufficiently to make their mining profitable.

Hall Mountain Area.--Thorium was discovered in 1955 in the dumps of the Golden Sceptre mine about 4 miles east-southeast of Porthill. Several other thorite ($ThSiO_4$) veins (Table 2 and Figure 6) have since been discovered in the area, including one 10 miles north of Hall Mountain in British Columbia. The Hall Mountain deposit has potential for production of thorium. On Hall Mountain thorium placer deposits are unlikely because thorite is not a resistant mineral which would readily be transported and concentrated as placers (M. H. Staatz, oral commun., 1978).

Other areas.--According to Castor and others (1977, p. 15), anomalous concentrations of thorium (greater than 20 ppm eTh) occur in three areas east and west of the Kootenai River Valley, in the Selkirk and Purcell Mountains (Figure 6). These areas may warrant further detailed sampling, but are not of interest with respect to Indian lands.

## Recommendations for Further Study

The Kootenai River valley probably contains peat deposits worthy of further investigation. Such an investigation on Indian lands would be difficult to justify because Indian lands constitute a small part of the valley. Presently there is little supportive evidence for further uranium evaluation in the Kootenai River Valley. However, the DOE's forthcoming uranium evaluation report on the Sandpoint 2° map may suggest that further examination in the valley and possibly on Indian land is warranted.

# COEUR D'ALENE INDIAN RESERVATION

## Geography

The Coeur d'Alene Indian Reservation is in Benewah and Kootenai Counties, Idaho. It consists of 69,299 acres, of which 16,236 acres are tribally owned, and 53,063 acres are allotted land. The reservation lies on the Washington-Idaho border, and surrounds about the southern third of Coeur d'Alene Lake (Figure 7).

Principal population centers are St. Maries, half of which is outside the reservation, Plummer (agency headquarters), Tensed, and Chatcolet. U.S. Highway 95 crosses the reservation from north to south and Idaho State Highway 5 crosses it from east to west, as does the Chicago, Milwaukee, St. Paul, and Pacific Railroad. The highest point on the reservation is Mount Engle, near the northeast corner, with an elevation of 5,412 feet. Lowest part is Coeur d'Alene Lake, at 2,125 feet above sea level (Figure 8).

## Physiography

The Coeur d'Alene Indian Reservation lies across the boundary between the Columbia Plateau and the Northern Rocky Mountains. The western part of the Northern Rockies consists of steep-sided, low mountains, gradually decreasing in elevation westward to become groups of more or less isolated hills. The Columbia Plateau is a lava plain built of successive, generally very large flows of basalt. Individual flows are mostly 50 to 200 feet thick. These flows gradually filled pre-existing valleys and encroached on the mountain front to the east. By the end of Miocene time, when the eruptions ended, the flows had produced a nearly flat surface at elevations of 2,500 to 2,700 feet, having covered all pre-existing surfaces that had lain at lower elevations. Thus valleys cut below 2,500 feet in the Northern Rockies were floored by basalt. At lower elevations, higher isolated hills or groups of hills (steptoes) were left surrounded by lava.

In the ten million years or so since the cessation of volcanic activity, the streams of the region re-established their courses. Major streams cut deep canyons into the basalt; the St. Joe-Coeur d'Alene confluence in what is now Coeur d'Alene Lake was at a point some 850 to 900 feet below the plateau surface. Other streams cut into the lava in proportion to their size. The general shape and relief of the hills and mountains above the old lava surface probably changed relatively little.

Beginning about a million years ago, dust storms from the west brought windblown silt eastward into what is now eastern Washington and northern Idaho. Successive deposits of that material, the loess now referred to as the Palouse Formation, continued to the present. The loess was mostly eroded off of the steep slopes of the Northern Rockies, but on the flat surfaces of the lava plateau it remained, forming deposits as much as 200 feet thick in places to the southwest. On the Coeur d'Alene reservation the Palouse Formation is probably closer to 50 feet in maximum thickness. It forms the richest, most productive soil in the region.

Pleistocene glaciation produced extensive changes in the country north of the reservation, but no glacial ice actually reached as far south as the reservation boundary. One glacial feature did affect the reservation, however. A glacial moraine at the town of Coeur d'Alene, about 14 miles north of the reservation, created a dam across the Coeur d'Alene-St. Joe Valley and produced Coeur d'Alene Lake, the large and beautiful lake that occupies a sizable area on the north boundary of the reservation. An interesting and unusual feature at the south end of Coeur d'Alene Lake is the channel of the St. Joe River. Since the formation of the lake, the river has extended natural levees into the main body of the lake, so that the river now maintains a discrete channel between the levees for a distance of some four miles into the south end of the lake.

## General Geology

Except for a highly generalized map, Figure 10, no geologic map of the Coeur d'Alene Reservation is included in this report. The geology of the reservation and of a large area around it is well shown in color on the 1:250,000 scale map by Griggs (1973). Reproduction of Griggs' map in black and white would require over-simplification and eliminate many important details of the geologic relationships. Such a map would serve no useful purpose. Griggs' map can be easily obtained from several U.S. Geological Survey offices; the one nearest the Coeur d'Alene Reservation is:

Public Inquiries Office
U.S. Geological Survey
678 U.S. Courthouse
920 W. Riverside
Spokane, Washington 99201.

The generalized stratigraphic column is shown in Table 3.

TABLE 3

Stratigraphic Column - Coeur d'Alene Indian Reservation

| | |
|---|---|
| Alluvium | Pleistocene and Holocene sediments in larger stream valleys |
| Palouse Formation | Pleistocene and Holocene loess |
| Columbia River Group and Latah Formation | Miocene basalt flows and interlayered lake sediments |
| Quartz monzonite | Intrusive granitic rock of late Mesozoic or early Tertiary age |
| Belt Supergroup | Precambrian |
| Libby Formation<br>Striped Peak Formation<br>Wallace Formation<br>St. Regis Formation<br>Revett Formation<br>Burke Formation<br>Prichard Formation | Generally biotite-grade metasedimentary rocks; predominantly siltites, quartzites, argillites; minor carbonate |
| Gneiss | Precambrian (Pre_Belt?) sillimanite-grade metasedimentary rocks |

The oldest rocks on the Coeur d'Alene Indian Reservation are intensely metamorphosed sedimentary rocks that crop out in the northwestern part of the reservation north of Benewah County and west of Coeur d'Alene Lake. Their origin and age are not positively known. Griggs (1973) believes them to be metamorphosed facies of the Belt Super group, whereas Weis (1968) believes them to be older. They are a group of quartz-feldspar--sillimanite-mica gneisses, schists, and quartzites that appear to be in fault contact with the much less metamorphosed, undisputed Belt Super group rocks to the south and east.

The Belt Supergroup is a thick group of rocks ranging from about 1,500 million years in age to about 750 million years in age. They are mudstones, siltstones, sandstones, and muddy carbonate sediments now metamorphosed to about biotite grade. Most show finely laminated bedding, ripple marks, mudcracks, and other features suggestive of deposition in shallow water of a slowly subsiding basin. Their stratigraphic sequence as mapped on the Coeur d'Alene Indian Reservation (Griggs, 1973) is shown in Table 3.

The Belt Supergroup rocks were metamorphosed, folded into broad, open anticlines and synclines, and cut by faults, some time between the end of Precambrian time and the beginning of the Cenozoic. During the late Mesozoic and early Tertiary, many rock formations of Idaho and Washington were intruded by magmas, mostly with a composition near quartz monzonite. Only one such intrusive is known on the reservation, a mass about a mile wide, half in Idaho and half in Washington, just 4 miles south of the northwest corner of the reservation.

The next geologic event to affect the area was the eruption of the Miocene Columbia River Basalt. As flows filled the stream valleys, drainages were blocked and lakes formed. Some of the lakes were overridden by later lava flows, in which pillow lavas and pillow-palagonite complexes were formed. Elsewhere, the lakes were filled or partly filled by sediments washed from the surrounding uplands. Where those sediments were covered and preserved by subsequent lava flows, they became the Latah Formation, the sedimentary unit that is contemporaneous with the Colombia River Basalt.

The climate of eastern Washington and northern Idaho was warm and wet until after the end of the Miocene, leading to the development of a very deeply weathered soil (saprolite), in places 300 feet thick, on top of the unweathered pre-basalt bedrock. The weathering converted feldspars to clay, thus much of the sediment that accumulated in the Latah is high in clay. In places the thick residual saprolite was protected by lava flows, and remnants can still be found scattered along the margins of the basalt. At least one basalt flow near the top of the sequence of flows also has a layer of saprolite on it, at least 50 feet thick in places (Hosterman, 1969). By the end of Miocene time the climate had changed to its present cooler and dryer character, and little additional surface weathering has taken place since then.

Approximately a million years ago, at the beginning of the Ice Age, windstorms from south central Washington began to spread a layer of silt across eastern Washington and northern Idaho. The loess deposition has continued at various rates until the present. Where it landed on the steep flanks of hills and mountains it was readily eroded, but on the flat surface of the basalt it remained, in places collecting in a layer as much as 200 feet thick. This deposit, the Palouse Formation, forms the rich soil that underlies the wheat fields of eastern Washington and northern Idaho today, including those parts of the lava plateau that form the flat areas on the Coeur d'Alene Indian reservation.

In late Pleistocene time, glaciers moving southward from Canada reached parts of northern Idaho, including an area 12 to 15 miles north of the reservation. A glacial moraine dam was formed there, restricting the St. Joe-Coeur d'Alene river water and forming Coeur d'Alene lake. The lake level is now artificially controlled and managed for water storage for hydroelectric power, but most of the water is still ponded by the Late Pleistocene dam of glacial debris, which is the only glacial feature that affected the reservation.

The only younger material on the reservation is alluvium, mostly as stream-transported channel and flood plain deposits along the major streams, and the accumulations of organic material on the larger flood plains to form peat such as that in the lower St. Joe Valley.

## Structure

The Precambrian rocks on the reservation have been folded and faulted, probably for the most part at the same time that they were metamorphosed. The folds are broad, open anticlines and synclines; dips rarely exceed 45 degrees. Most of the faults mapped by Griggs (1973) are shown with vertical displacement, but may have had some or considerable horizontal offset as well.

It is possible that the faulting developed over a considerable period. In the Coeur d'Alene mining district, about 20 miles to the east, detailed studies show that some faulting took place before mineralization, and some took place later. Structures that were open before mineralization were channels for bleaching solutions. Later movement closed some, left open others, and locally produced new ones. Only structures open at that later period were mineralized. Still later, new faults offset some of the ore bodies and further movement took place on some of the pre-existing mineralized and unmineralized structures (Weis, in Fryklund, 1964). It is likely that the faults on the reservation may span a similarly long time, but no information exists to indicate their timing or age relations.

Little deformation has occurred since the beginning of the Miocene. Some basalt flows reach an elevation of a little more than 2,700 feet in the St. Joe and St. Maries valleys, an elevation about 200 feet higher than presumably equivalent flows farther west, indicated slight tilting of the area since the end of Miocene time. This is a part of the same gentle warping of the region that tilted the entire plateau.

## Economic Geology

The known and potential mineral resources of the Coeur d'Alene Indian Reservation are of two general types: those made up of major rock units or parts of rock units, and those made up of material introduced into pre-existing rock units long after the units were formed. The first class is by far the larger, and probably has by far the greater value.

The Columbia River Basalt and the Latah Formation are the rock units with greatest potential value, although the Precambrian rocks may locally be of value as well. The basalt has long been used as an excellent source of road metal, and probably will continue to be in the future. It has unknown, but possibly considerable potential value as a source material for the manufacture of insulating fiber.

Parts of the Latah Formation contain a high percentage of clay of value in the fabrication of refractory materials such as brick, tile, and related products. Saprolite, the intensely weathered residual material that may be produced from most rocks, also contains clay. Weathered basalt contains the clay mineral halloysite; the Precambrian rocks contain the clay mineral kaolinite (Hosterman, 1969). Both are used in the manufacture of refractories.

The largest deposits and best quality clays are in the Latah Formation. These deposits formed by the transport of clays from surrounding weathered bedrock and deposition in locally extensive, relatively pure layers. Basalt saprolite is known on at least one lava flow, generally near the top of the sequence of flows in this region. Saprolite developed on older rocks also remains in places where lava flows protected it from later erosion. The quality of the clays in those deposits is largely dependent upon the abundance of the mineral feldspar in the original rock; most formations in the Belt supergroup contain only small quantities of feldspar. In general, the ultimate potential of either basalt rock or clay is more a matter of marketing than of intrinsic value.

In places, rocks older than the Columbia River Basalt are cut by veins. Some of those veins may contain valuable metals such as lead, zinc, and silver, as they do in the Coeur d'Alene mining district east of the reservation. Veins explored so far in the northeastern part of the reservation are relatively small, discontinuous, and low grade, but it is possible that larger, higher grade veins may exist. Veins with valuable metal content may not crop out at the surface, and exploration for concealed deposits is a risky and expensive proposition unless geologic evidence can be used to narrow the targets. Geochemical sampling of soils, rocks, and stream sediments has been used effectively in some areas to locate the most favorable places for exploration; but deeply buried veins cannot be located with certainty by any method of surface study now in use.

Veins in the southern part of the reservation have been prospected as possible sources of iron. They contain hematite and limonite apparently formed by the weathering of iron sulfides in the veins. If that is the origin of the hematite at the surface, usable iron ore would extend to a depth of only a few hundred feet at most, and would probably constitute too small a deposit to warrant mining. Such veins should be sampled for analysis, however, to test for the presence of metals that might be present in economic amounts at depth.

## Metallic Mineral Resources

The southern parts of the Medimont and Lake Front, and western part of the St. Joe mining districts extend into the northeast portion of the Coeur d'Alene Indian Reservation. Exploration for base metals has been widespread in these districts, but mine production has been insignificant. In the northeast part of the reservation a number of small mines and three blocks of patented claims have resulted from lead, zinc, and silver exploration. Several iron deposits occur in the southern and western parts of the reservation. Two of these, described under "Iron", have a record of production.

### Lead-Zinc-Silver

The following information on claims and workings has been abstracted mainly from Anderson, 1928, p. 17-20, and 1940, p. 52-53, (Figure 9).

Jumbo Claim Group.--The Jumbo claim group is in secs. 1 and 12, T. 47 N., R. 2 W., one-half mile west of Indian lands. According to Bureau of Land Management (BLM) mineral survey plat No. 3089, development consists of four shafts and two adits. These claims may also be the Rainbow No. 4 which is a short distance north of the main claim groups owned by Rainbow Mining Co. (see next section). Anderson did not visit the Rainbow No. 4 claims, but mentions that there are 600 feet of adits.

Rainbow and Butte Mining Companies.--The Rainbow and Butte Mining Companies have patented claims near Indian land in secs. 17, 18, 19, and 20, T. 47 N., R. 1 W., in Kootenai and Benewah Counties. BLM mineral survey plats indicate that the Rainbow Mining Co. patented the Buffalo, Elephant, Victory, and Ulysses claim groups. Anderson (1940, p. 52) refers to these claims as the Rainbow No. 3 group. The Butte Mining Co. patented the Independent and possibly the Rex groups. Together the two companies have about 20 patented and 10 unpatented claims. Six patented, and five unpatented claims of the Butte Mining Co. were acquired by the Rainbow Mining Co. before 1940. The present ownership of these claims is not known. The main structure extending from the Butte to the Rainbow mining properties is a west-northwest trending breccia zone in impure quartzite of the lower Prichard Formation. At the Butte property, the zone strikes N. 3º W., is nearly vertical, and contains a sulfide-bearing quartz vein which forms a prominent rust-red outcrop.

Alteration in the breccia zone is as much as 200 feet wide, and varies in intensity. The quartzite is dark gray where slightly altered, and light gray where alteration is intense. Slight alteration is characterized by the minerals sericite, chlorite, and biotite. Intense alteration is characterized by the absence of these minerals and the appearance of quartz, calcite, and sulfide minerals. Sulfide minerals include pyrrhotite, sphalerite, arsenopyrite, pyrite, galena, and some chalcopyrite, associated with lesser amounts of ankerite, calcite, and quartz. Sulfide minerals are not uniformly distributed through the altered zone, but occur as small fracture fillings and replacement veins. Pyrrhotite is the most abundant sulfide, but there are local concentrations of sphalerite and galena.

Combined development and exploration of both properties consists of about 6,000 feet of adits and crosscuts (McDowell, 1952, p. 71), and 300 feet of diamond drilling. A 300-foot adit on the Butte property exposed a vein, at least 8 feet thick, containing pyrrhotite and arsenopyrite with local concentrations of sphalerite and galena. Thirty-eight feet of sulfide minerals were intersected by diamond drilling. Core samples of this zone assayed 11.2 percent lead and 8 ounces silver per ton. Location of this hole, in relationship to adit, was not stated. About 400 feet east of the Butte adit, a 135-foot adit driven N. 35º E. on the Rainbow No. 3 claims intersected the same vein. From this adit, 2,450 feet of crosscuts and 1,500 feet of drifts have been driven. The mineral assemblage is similar to that exposed in the Butte adit, but details are not given.

Green Back Claim Group.--The Green Back claims are on Indian land, near the summit of Engle Mountain, in sec. 30, T. 47 N., R. 1 W. A 12-foot thick quartz vein, striking northwest, contains a little iron staining. It has been exposed by a small cut.

Big Five Claim Group.--The Big Five group consists of six unpatented claims near the head of Street Creek in sec. 29, T. 47 N., R. 1 W., just east of the reservation boundary. A 300- to 400-foot adit (now caved) was driven along a vertical vein striking N. 50º W. Composition of the vein appears similar to that exposed by workings of the Butte and Rainbow No. 3 claims. Dump material contains iron-oxides, cerussite, some pyromorphite, and scattered arsenopyrite, pyrrhotite, pyrite, and galena. Gangue minerals include calcite and quartz. A second adit, 350 feet long, is 100 feet west of the first, and follows a similar but less well mineralized vein, which strikes N. 55º W. and dips 70º SW. The vein consists of brecciated quartzite cemented and replaced by quartz and calcite containing pyrrhotite and chalcopyrite. Considerable malachite is reportedly on the dump.

Hired Girl Claim Group.--The Hired Girl claim group is on Street Creek in sec. 29, T. 47 N., R. 1 W, three-quarters of a mile south of the Big Five claims. The replacement vein, also in a brecciated quartzite zone, is resistant to weathering and forms a prominent outcrop. It strikes N. 75º W. and was exposed for 170 feet by an adit. The vein contains sulfides, mainly pyrite, with lesser amounts of pyrrhotite, arsenopyrite, and chalcopyrite. Galena was not noted on the dump or in the adit.

Monarch Claim Group.--The Monarch claims are in sec. 32, T. 47 N., R. 1 W., about one-half mile south of the Hired Girl claims. The vein is similar to the others described, but is vuggy and more porous. It strikes N. 40º W. and dips 70º NE. Pyrrhotite is the dominant sulfide mineral, with variable amounts of arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, and perhaps, tetrahedrite. Galena occurs locally in appreciable amounts. A 900-foot adit, with about 130 feet of crosscuts, and a winze have been driven along the vein. At the face, the vein strikes N. 45º W. and dips 80º SW. A small ore shoot encountered in the vein reportedly contains a high sulfide concentration,

Silver Star Claim Group.--On the south slope of Engle Mountain, at the head of Warren Creek, this claim group consists of four unpatented claims in sec. 31, T. 47 N., R. 1 W. Several fissure-filling veins occur in quartz diorite. The largest vein strikes N. 73º E. and dips about 40º N. As much as 16 feet wide, it consists mainly of barren quartz with some iron-stained, vuggy areas. A 290-foot adit driven from the creek failed to intersect this vein. Another vein strikes N. 70º W., dips 43º NE., and has been explored by several small cuts. Unoxidized vein material from the cuts shows scattered galena, sphalerite, and chalcopyrite. One select sample taken by the property owners assayed 0.68 to 0.91 ounces gold per ton. Anderson (1928, p. 24) stated the best areas for prospecting would be beneath honeycombed and iron-oxide encrusted parts of the vein.

### Iron

The following information is abstracted from the U.S. Bureau of Mines mineral property files which include an unpublished report by Roby and others (1966, p. 203-210) (Figure 9).

Liberty Butte (LeFors) Deposit.--Iron occurs at the Liberty Butte deposit in the E ½ SW ¼, W ½ SE ¼, and SE ¼ SE ¼ sec. 7, and the NW 14/ NE ¼ sec. 18, in T. 44 N., R. 5 W., Benewah County. The deposit is about 3 miles west of Tensed, Idaho.

The iron at Liberty Butte is in a vein which strikes N. 80º W. and dips 60º SW. The vein cuts altered shales and slates of the Precambrian upper Wallace Formation. The outcrop is about 400 feet long, 36 feet wide at the east end, and tapers to 6 feet at the west end. Core drilling indicates the vein is continuous to a depth of about 200 feet. The main iron minerals are hematite and limonite, crossed by numerous quartz veinlets.

Two additional exposures of hematite and limonite are about 250 and 500 feet east of the east end of the main outcrop. These exposures may represent faulted or folded segments of the main vein.

Resources of the Liberty Butte deposit are approximately 5,000 tons of measured and 100,000 tons of inferred ore assaying about 50 percent iron. Production has been limited to seven carloads of fluxing ore shipped between 1919 and 1923 to the Bunker Hill Smelter, Kellogg, Idaho.

DeSmet (McCleary Butte) Deposit.--A vein--type deposit of limonitic iron occurs at the DeSmet deposit in the S ½ SE ¼ sec. 21, T. 44 N., R. 5 W., Benewah County, about 2 miles southeast of Tensed, Idaho.

Two principal and a number of small veins are exposed on the property. They contain high-grade iron, probably from oxidized sulfide minerals. The country rock is an argillaceous quartzite of the Precambrian Striped Peak Formation (Griggs, 1973) that strikes northwesterly and dips southwest. The veins strike N. 60º to 70º W. and dip steeply southwest.

A 12-foot wide by 450-foot long section of the northern vein, and some of the southern vein have been mined. In the 1960's these two veins yielded at least 25,000 tons of ore which was used in cement manufacture. Deposit reserves are estimated at 278,000 tons, averaging 50 percent iron.

Patterson Prospect.--The Patterson prospect is in sec. 1, T. 43 N., R. 4 W., about 9 miles southeast of Tensed, Idaho. Small pieces of hematite, from less than an inch to several inches thick, have been exposed in shallow ditches alongside the county road. The ground is stained red over an area several hundred feet wide, but its relation to a possible buried iron-bearing zone is unknown. No production from the property has been reported.

Atkinson Prospect.--The Atkinson prospect is in sec. 32, T. 44 N., R. 4 W., several miles northwest of the Patterson prospect. A small amount of low-grade iron-oxide float, mixed with slaty or shaly quartzite, has been found; it appears to be of no economic value.

Tensed Prospect.--The Tensed prospect is in sec. 1, T. 44 N., R. 5 W., approximately 1.5 miles northeast of Tensed, Idaho. Hematite float has been reported in an area 70 to 80 feet wide along a county road. In a plowed field northeast of the road, red iron staining covers an area several hundred feet long by, perhaps, one hundred feet wide. This prospect is probably near the Tensed mine which is described under "Clay."

Eklund Prospect.--The Eklund prospect is about 7 miles west of Plummer, Idaho, in secs. 19 and 20, T. 46 N., R. 5 W. Well-developed pyrite crystals are the main iron-bearing mineral in this prospect.

Unnamed Prospect.--According to the Idaho Bureau of Mines (Carl Savage, personal commun., 1978), there is an iron prospect in the NW ¼ NE ¼ sec. 16, T. 43 N., R. 4 W. The prospect consists of a pit 4 feet long, 4 feet wide, and 4 feet deep. Iron occurs as specular hematite seams in the lower Wallace Formation of the Precambrian Belt Supergroup. No other information could be found on this prospect.

## Nonmetallic Mineral Resources

### Sand and Gravel and Crushed Rock

Geological Survey topographic maps show numerous sand and gravel pits in and near the reservation. Most of the pits shown are rock quarries where various sizes of crushed rock are produced as a sand and gravel substitute. Hauling sand and gravel is not economically competitive with nearer-to-market crushing operations (Marks, 1975). Most crushed rock is from basalt, with some production of argillite and quartzite. Crushed argillite has not been satisfactory in road construction because it decomposes readily. Quartzite is durable, but expensive to crush.

Numerous crushing operations, owned or operated by private companies or the Idaho State Highway Department, have been sources of sand and gravel, and crushed rock within the boundaries of the Coeur d'Alene Indian Reservation (Figure 10). The only producing quarry on Indian-owned land is the Plummer quarry in the SW ¼ sec. 8, T. 46 N., R. 4 W. Bureau of Indian Affairs records from 1966 to 1977 show that 95,300 cubic yards of basalt have been taken from this quarry, and royalties of $6,201 have been paid to the tribe. The quarry is leased by the Plummer Gateway Highway District.

## Clay

The Miocene Latah Formation and, to a lesser extent, the Pleistocene Palouse Formation in eastern Washington and northern Idaho contain extensive clay deposits. Producing clay mines are at Fairfield (7 miles west of the reservation), Mica (8 miles northwest of the reservation), and the Tensed mine (within the reservation); they are owned or leased by the Interpace Corporation.

Tensed Mine.--The Tensed mine is on private land in sec. 1, T. 44 N., R. 5 W., about 1.5 miles northeast of Tensed (Figure 10). The Tensed clay is mostly red and yellow kaolinite averaging 19 percent $A1_20_3$, 7 percent FeO, 2.3 percent $K_20$, and 63 percent $SiO_2$. Trucked to the plant at Mica, it is manufactured into red facing brick and tile. Reportedly extensive, the deposit may extend into surrounding Indian land.

Saxby Area.--The U.S. Geological Survey has outlined four good clay deposits in the Latah Formation near Saxby, and in the northwest corner of the reservation (Hosterman, 1969). The area was tested by 37 auger holes; 20 were near or within the reservation boundary but not on Indian land. Most clay deposits are blanketed by 2 to 20 feet of the Palouse Formation. Drill hole logs with chemical and physical data for these 20 holes are listed in Appendix D and Appendix E. The Interpace Corporation has indicated the area is favorable for future clay production.

The following information on three of the Saxby area clay deposits has been abstracted from Hosterman (1969, p. 48-49) (Figure 10).

South and east of McGowan Butte in the E ½ sec. 13 and the N ½ sec. 24, T. 48 N., R. 6 W., is a 250-acre clay deposit. Material from three auger holes (116, 136, and 139) indicates the Latah Formation averages 20 feet in thickness, and consists of varying proportions of sand, silt, and clay.

A 400-acre deposit, most of which lies north of the reservation, is located in secs. 1 and 2, T. 48 N., R. 6 W., and secs. 5 and 8, T, 48 N., R. 5 W. Results from seven auger holes (117, 118, 121, 125, 126, 127, and 135) show that the local average thickness of the Latah Formation is 36 feet, consisting of an assortment of clay, silt, and sand. Of the seven holes, only No. 135 is within the reservation boundary. It was not assayed, but the drill log indicates good clay at a depth of 15 to 25 feet.

Auger holes 131, 133, and 134 outline a 250-acre clay deposit, mainly in the E ½ sec. 8 and the NE ¼ sec. 17, T. 48 N., R. 5 W, The Latah Formation locally averages 3 feet in thickness, and contains clayey sand, silty clay, and sandy clay.

Basalt saprolite, a soft, earthy, clay-rich, thoroughly decomposed rock, formed in place by chemical weathering, underlies the Saxby deposits and was intersected in 23 of the 37 auger holes. It covers at least 5.5 square miles with an average depth of 17 feet (Hosterman, 1969, p. 49). Saprolite from the Columbia River Basalt is composed of 80 to 95 percent halloysite and 5 to 20 percent ilmenite and limonite (Hosterman, 1969, p. 17). On the reservation, saprolite occurs in holes 131 through 136 and 139 through 141. Eleven samples from these drill holes averaged about 24 percent $A1_2O_3$ and 4 percent $TiO_2$. A select sample of saprolite, 116A, contained 36 percent $A1_2O_3$, while sample 131D contained 9.5 percent $TiO_2$ (Appendix E).

Since World War II, high alumina clays in the United States have been considered possible sources of aluminum. Clays in Georgia have such a potential if the alumina refining technology develops. High alumina clays in the Northwest may also be a potential source.

Other Areas.--Other potential clay production areas being investigated by the Interpace Corporation are in the center- of secs. 15 and 16 , T . 45 N ., R. 5 W., and secs. 33 and 34, T. 47 N., R. 5 W. (Figure 10). Clay from these areas is suitable for various types of face brick (D. E. Herschfeld, personal commun., 1978).

Clay from exposures along railroad cuts from St. Maries to Chatcolet have been sampled and tested by the Idaho Bureau of Mines (Steels, 1920, p. 24-28, 36-37). Most were found suitable for common and face brick, drain and roofing tile, and structural wares (Table 4). None of these deposits occurs on Indian lands. High alumina clay has also been reported by the Idaho Bureau of Mines (Carl Savage, personal commun., 1978) along Benewah Creek and 3 miles northwest of St. Maries. No details of these deposits were available at the time this report was written.

High alumina clays have been found on the Robert Hyde Ranch, in secs. 24 and 25, T. 45 N., R. 4 W. (Figure 10). The owner estimates his main deposit is 600 feet long, 400 feet wide, and 40 feet thick. No analyses have been made of clay from this deposit (U.S. Bureau of Mines mineral property file).

### Shale

Several areas containing shale of the Latah Formation are also being evaluated by Interpace Corporation. These deposits occur about 1 mile west of St. Maries, 21 miles west of Plummer, and on Indian land 3 miles southeast of Plummer, near the BIA headquarters (Figure 10). A mixture of 90 percent ground shale from these deposits and 10 percent plastic clay is used to produce "thru-the-wall" bricks 16 inches long, 5 to 8 inches wide, and 4 inches thick. This line of brick may be marketed in the future.

### Cobbles

Extensive cobble deposits in the southern part of the reservation have been mapped by the Idaho Bureau of Mines (Carl Savage, personal commun., 1978). The most extensive deposits occur as a northwest-trending belt in T. 44 N., R. 4 W. (Figure 10). Deposits contain rock varying from silty to pure quartzite, and ranging in size from pebbles to boulders as large as 2 feet in diameter. Size fractions, the amount of dilution with finer material, and the thickness of these deposits are unknown. Select, high purity quartzite cobbles may be suitable for use in the grinding of ceramic material, or when iron contamination from ferroalloy grinding media presents a problem.

## Building Stone

Quartzite.--White, high purity quartzite of the Revette or possibly the Prichard Formation occurs in sec. 14, T. 44 N., R. 3 E., at the summit of Marble Mountain, about 20 miles southeast of St. Maries. John Stentz of the U.S. Forest Service thought this quartzite might be a potentially economic source of building stone (Marks, 1975, p. 62-63).

On the reservation, the Revette Formation (Griggs, 1973) crops out in secs. 2, 25, 26, 34-36, T. 47 N., R. 3 W. (Figure 10), areas worthy of investigation as sources of high purity quartzite or building stone.

Flagstone.--Northwest of Moses Mountain, in secs. 2, 3, 11, 12, and 13, T. 44 N., R. 4 W., (Figure 10), are outcrops of the Striped Peak Formation. The rock is a gray silty quartzite which breaks into sheets several inches thick, some of which display an interesting ripple-mark texture. It may have commercial application as an architectural facing stone for buildings, fireplaces, and walkways. The formation crops out locally on a dip slope of about 35° which suggests the possibility of gravity quarrying. Most of the area is accessible by road (Carl Savage, Idaho Bureau of Mines, personal commun., 1978).

## Basalt Fiber

About 50 percent of the Coeur d'Alene Indian Reservation is covered by basalt (Figure 10). Chemical composition of this basalt may be suitable for manufacture into fiber. In this process degassed pellets of basalt are heated until molten, drawn through a nozzle, and the fiber wound on a drum. Although there are no basalt fiber production plants in the United States, such operations exist in Russia, Germany and Italy (Raff, 1974, p. 76)[1]. The fiber is used as insulation and has characteristics similar to glass wool insulation. It is also used as a reinforcement in polymer and polyester products such as asphalt roofing, fiberglass, and conveyor belts. Industries in the Kalenborn region of West Germany developed a process which uses basalt to produce fused-cast linings resistant to erosion and corrosion. The German basalt contains the minerals melilite and leucite which enable it to be effectively annealed after crushing and melting. The process produces a highly resistant surface. Industrial application includes linings for hoppers, flumes, pipes and

[1]According to an article in the May 4, 1979 Spokesman Review, Gecepa Firm, an Austrian company, is interested in northwest basalt as a source of mineral wool production. Gecepa was one of nine Austrian firms to visit Spokane as part of the first Austrian trade mission to Washington state.

conveyors. Germany currently supplies all fused-cast linings for the U.S. market.

Work at the University of Idaho (Wallenwaber and Daily, 1975) has focused on the economic feasibility of producing insulation grade basalt fiber. Their conclusions suggest that, because of rising energy costs and economic growth, a sizable potential market exists in the Pacific Northwest.

Researchers at Washington State University (Subramanian and others, 1975-1977) are studying the technical aspects of basalt fiber production and applications. Their tests on basalt in Washington, Oregon, and Idaho indicate the fiber is suitable for insulation and for polymer and polyester reinforcement. Fused- cast linings produced from basalt remain a potential industry as the technology develops.

### Peat[2]

Peat occurs along the St. Joe River east and west of St. Maries (Savage, 1964, p. 146). A more detailed soil survey by Weisel (1975) indicates a substantial amount of Pywell muck (decomposed peat) mainly in secs. 15, 17, and 18, T. 46 N., R. 2 W and secs. 2, 23, and 13, T. 45 N., R. 3 W.(Figure 11). These areas also contain other soils that may have varying amounts of peat. None of these peat deposits is on or near Indian lands.

## Energy Resources

### Uranium[3]

Lands within the U.S. Geological Survey Spokane 2º topographic map, including the Coeur d'Alene Indian Reservation, are currently being investigated under the Department of Energy's (DOE) National Uranium Resource Evaluation Program. Airborne gamma ray spectrometer and magnetic surveys have been completed, and ground water, hydrogeochemistry, and stream sediment fieldwork has begun. Reports on these surveys will be released by the DOE.

Lenty Prospect.--According to the Idaho Bureau of Mines (Hubbard, 1955, p. 1,4), the Lenty prospect is either in NE ¼ sec. 25, T. 45 N., R. 4 W., or in NW ¼ sec. 17, T. 45 N., R. 4 W. The owner of this prospect reports fluorescent minerals in Precambrian sandstones and shales on the north side of a road in NE ¼ sec. 25. He also reports increased radioactivity along a logging road in sec. 30, T. 45 N., R. 3 W. (Figure 9).

Varney Prospect.--The Idaho Bureau of Mines (mineral property file, 1955, p. 1) locates this prospect in the SE ¼ SE ¼ sec. 15, T. 43 N., R. 4 W., on a north-trending ridge on the north side of the Hoodoo Mountains. Two small pits in siltstone and shale of the Libby Formation registered 3 times background on a scintillometer.

[2]See peat-lignite-uranium association under Kootenai Indian lands.

[3]See uranium, Kootenai Indian Reservation.

## Recommendations for Further Study

The full extent of the basalt and the clays of the Latah Formation are not completely known; however, enough is known at present so that if any attempts are made to exploit either resource, ample quantities can be located. Total appraisal of both would require 1:24,000-scale mapping and sampling for clay evaluation in about the western one-third of the reservation. Clay, shale, quartzite, flagstone, and cobble deposits on Indian land should be further sampled and evaluated to stimulate interest in their development. Fiber-grade basalt is likely to occur on the reservation, about half of which is covered by basalt. The economics of a fiber industry are worthy of consideration.

Knowledge of the potential for metal-bearing veins is incomplete. Chances for finding major deposits appear small, but full evaluation of the mineral potential of the reservation would require geochemical sampling of veins, altered rocks, soils, and stream sediments in the northeastern one-fourth of the reservation in the Precambrian rocks north of the St. Joe River, and sampling the known occurrences of the iron-rich soil and rock in the southern part of the reservation. If that type of study were to be undertaken, a systematic program of sampling could be laid out, semi-quantitative spectrographic analyses could be made, and results could be evaluated in terms of mineral resource potential. A preliminary reconnaissance stream sediment sampling program is recommended in approximately the northeastern one-fourth of the reservation.

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# APPENDICES

**APPENDIX A**--Topographic Map Index, Kootenai Indian Lands, Idaho

**APPENDIX B**--Topographic Map Index, Coeur d'Alene Indian Reservation, Idaho

## APPENDIX C

Airphoto Coverage, Kootenai Indian Lands and the Coeur D'alene Indian Reservation, Idaho

| Photo type | Date | | |
|---|---|---|---|
| Aerial black and white and color | 1974 | 1 inch = 0.25 mile | Carto Photo, Eugene, Oregon |
| Black and white orthoquads | 1974 | 1 inch = 2,000 feet | Department of Lands, BIA Portland, Oregon |

Information on coverage by Landsat, Sky Lab, NASA-aircraft, and aerial mapping photography in black and white, false color, color, or color infrared for any geographic location can be obtained from:

Eros Data Center
U.S. Geological Survey
Sioux Falls, South Dakota 57198

**APPENDIX D**--Auger Hole Logs of Clay Samples, Coeur d'Alene Indian Reservation, Idaho

**APPENDIX E**--Chemical Composition, Grain Size Distribution, and Clay Minerals in Select Auger Holes, Coeur d'Alene Indian Reservation, Idaho.

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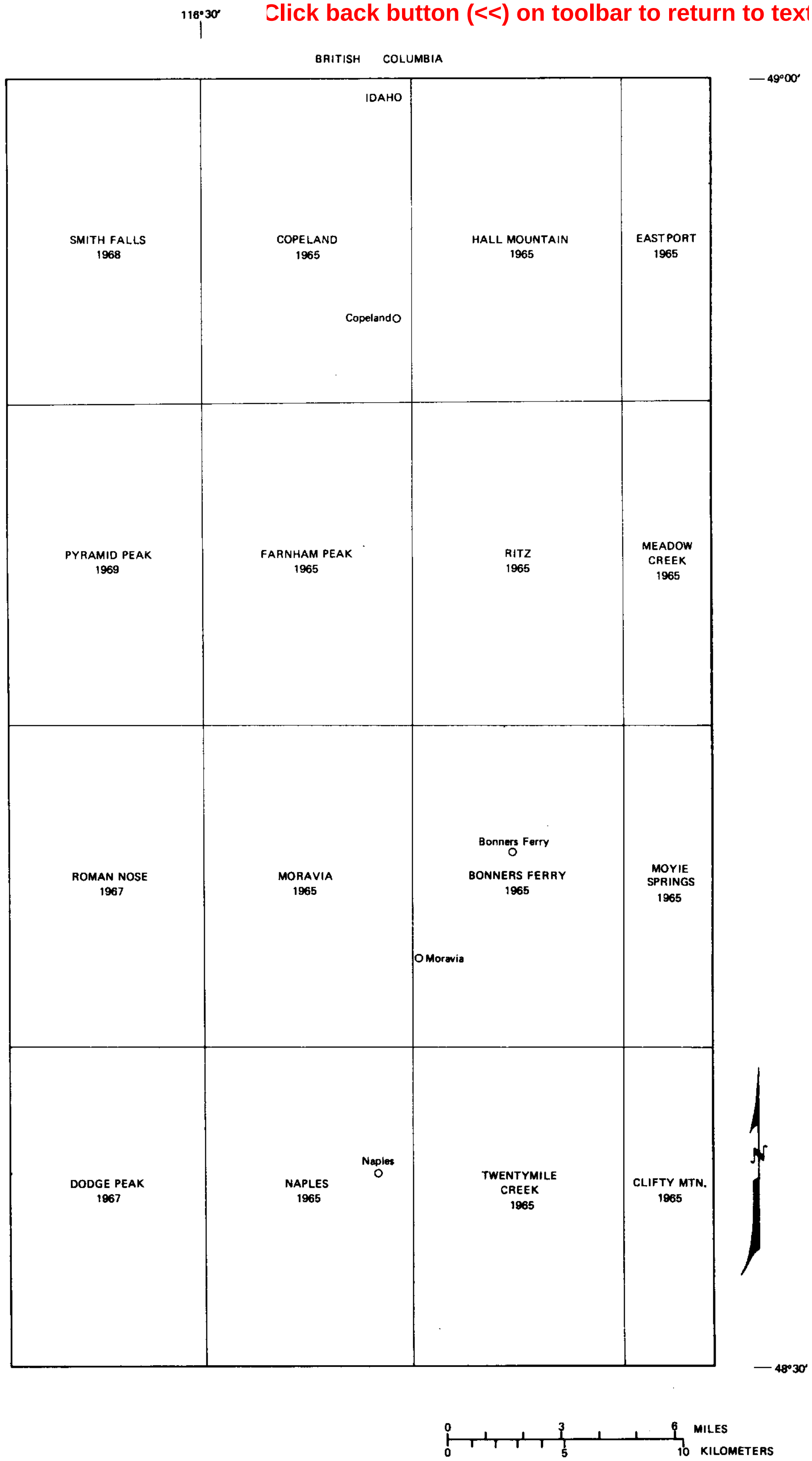


APPENDIX A.--Topographic map index, Kootenai Indian lands, Idaho.

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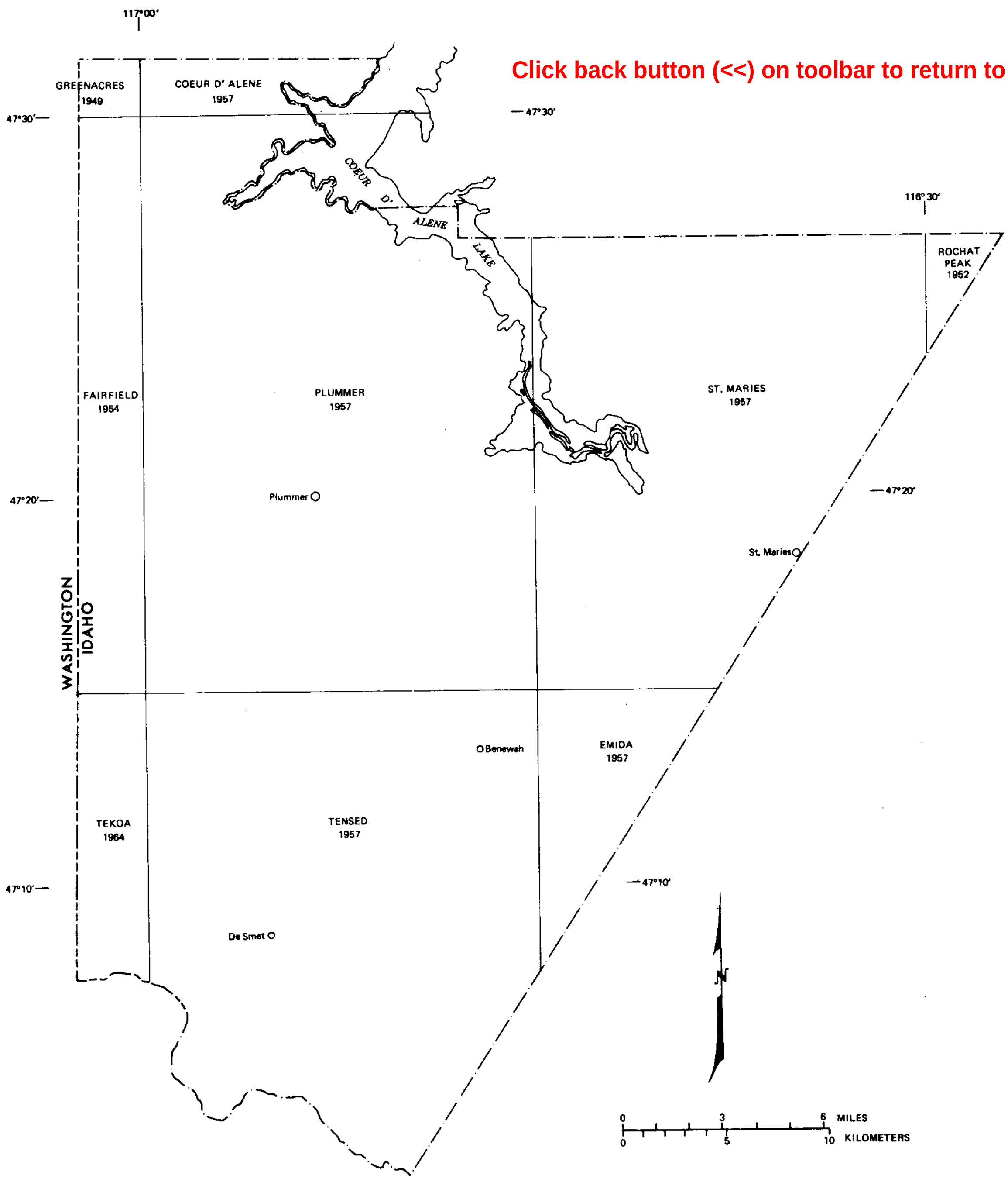


APPENDIX B.--Topographic map index, Coeur d'Alene Indian Reservation, Idaho

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APPENDIX D.--Auger hole logs of clay samples Coeur d'Alene Indian Reservation, Idaho

(Data from Hosterman, 1969, p.77-82)

| Formation | | Sample depth (feet) | Description |
|---|---|---|---|
| Auger hole 116; elev. 2,680 ft; sec. 12, T. 23 N., R. 45 E. | | | |
| Palouse- - - - - - - - | | 0-8 | Clayey silt. |
| | | 8-10 | Sand and gravel. |
| Latah- - - - - - - - - | | 10-15 | Silty clay, dusky-yellowish-orange (7.5YR 6/6) 1/ |
| | | 15-30 | Sandy clay, light-yellowish-brown (10YR 6/3). |
| Basalt - - - - - - - - | A | 30-42 | Saprolite, yellowish-gray (10YR 7/1). |
| | | 42-45 | Saprolite, bluish-gray (5B 5/1). |
| | | 45-48 | Saprolite, olive-gray (5Y 4/1). |
| | | 48-60 | Saprolite, olive-black (5Y 2/1). |
| Auger hole 117; elev. 2,595 ft; sec. 31, T. 23 N., R. 46 E. | | | |
| Palouse- - - - - - - - | | 0-15 | Clayey silt. |
| Latah- - - - - - - - - | | 15-28 | Clayey micaceous sand, weak-yellowish-orange (10YR 7/4). |
| | | 28-34 | Carbonaceous micaceous clay, brownish-black (10YR 2/1). |
| Basalt- - - - - - - - | | 34-36 | Saprolite, light-bluish-gray (5B 7/1). |
| | | 36-40 | Saprolite, olive-gray (5B 7/1). |
| | | 40-50 | Saprolite, olive-black (5Y 2/1). |
| Auger hole 118; elev. 2,605 ft; sec. 31, T. 23 N., R. 46 E. | | | |
| Palouse - - - - - - - | | 0-14 | Clayey silt. |
| Latah- - - - - - - - | A | 14-20 | Silty sandy clay, light-gray (N8). |
| | B | 20-40 | Clayey silty sand, weak-yellow (2.5 Y 8/2). |
| | C | 40-60 | Clayey sand, yellowish-gray (10YR 8/1). |
| | D | 60-85 | Clayey sand, yellowish-gray (10YR 7/1). |
| | E | 85-100 | Silty sandy clay, brownish-gray (10YR 3/1), carbonaceous. |

1/ Color designations from 1954 edition of "Munsell Soil Color Charts" Published by Munsell Color Co., Inc., Baltimore, MD

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Auger Hole Logs (continued)

| Formation | Sample depth (feet) | Description |
|---|---|---|
| Auger hole 121; elev. 2,645 ft; sec. 1, T. 48 N., R. 6 W. | | |
| Palouse - - - - - - - - - | 0-7 | Clayey silt. |
| Latah - - - - - - - - - - | 7-10 | Micaceous clayey sand, weak-yellowish-orange (10YR 7/4). |
| Basalt- - - - - - - - - A | 10-27 | Saprolite, light-brownish-gray (10YR 5/1). |
| | 27-28 | Saprolite, bluish-gray (5B 5/1). |
| | 28-31 | Saprolite, olive-gray (5Y 4/1). |
| | 31 | Rock. |
| Auger hole 125; elev. 2,615 ft; sec. 5, T. 48 N., R. 5 W. | | |
| Palouse - - - - - - - - - | 0-4 | Clayey silt. |
| | 4-10 | Sand and gravel. |
| Latah - - - - - - - - - - | 10-12 | Silty clay, moderate-yellow (2.5Y 7/6). |
| | 12-16 | Clay, light-gray (N7). |
| | 16-20 | Micaceous silty clay, very pale-brown (10YR 4/2). |
| | 20-24 | Micaceous sand, weak-brown (10YR 4/2). |
| | 24-30 | Silty clay, pale-reddish-brown (10YR 5/4). |
| | 30-35 | Clayey sand, pale-brown (5YR 5/2). |
| | 35-47 | Clayey micaceous sand, yellowish-gray (10YR 7/1). |
| | 47-57 | Silty clay, brownish-black (10YR 2/1) carbonaceous. |
| Basalt - - - - - - - - - | 57-67 | Saprolite, dark-bluish-gray (5B 3/1). |
| Auger hole 126; elev. 2,650 ft; sec. 8, T. 48 N., R. 5 W. | | |
| Palouse - - - - - - - - - | 0-6 | Clayey silt. |
| | 6-7 | Sand and gravel. |
| Latah - - - - - - - - - - | 7-12 | Sandy micaceous clay, pale-brown (2.5Y 5/2). |
| | 12-18 | Clayey micaceous sand, moderate-yellowish-brown (7.5YR 5/6). |
| | 18-27 | Silty clay, moderate-yellowish-brown (10YR 5/6). |
| | 27-35 | Silty clay, yellowish-gray (10YR 8/1). |

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Auger Hole Logs (continued)

| Formation | | Sample depth (feet) | Description |
|---|---|---|---|
| Auger hole 127; elev. 2,650 ft; sec. 8, T. 48 N., R. 5 W. | | | |
| Palouse - - - - - - - - - | | 0-5 | Clay silt, gravel at base. |
| Latah - - - - - - - - - - | | 5-8 | Clayey sand, dusky-yellowish-orange (7.5YR 6/6). |
| | | 8-10 | Sandy silty clay, weak-yellow (2.5Y 7/2). |
| | | 10-15 | Clayey silty sand, moderate-yellowish-brown (10YR 5/4). |
| | | 15-25 | Clayey silt and sand, light-olive-green (2.5Y 5/4). |
| | | 25-35 | Clayey silt, moderate-yellowish-brown (10YR 5/4). |
| | | 35-60 | Silty clay, moderate-yellowish-brown (10YR 5/6). |
| | | 60-65 | Clay, light-gray (N7). |
| | | 65-70 | Rock. |
| Auger hole 129; elev. 2,580 ft; sec. 9, T. 48 N., R. 5 W. | | | |
| Palouse- - - - - - - - - | | 0-12 | Clayey silt. |
| | | 12-13 | Sand and gravel. |
| Basalt - - - - - - - - - | A | 13-24 | Saprolite, yellowish-gray (10YR 7/1). |
| | B | 24-34 | Saprolite, brownish-gray (10YR 4/1). |
| | | 34 | Rock. |
| Auger hole 130; elev. 2,620 ft; sec. 9, T. 48 N., R. 5 W. | | | |
| Palouse- - - - - - - - - | | 0-6 | Clayey silt. |
| | | 6-7 | Sand and gravel. |
| Pre-Tertiary - - - - - - | | 7-10 | Saprolite, sandy micaceous clay, weak-yellowish-orange (10YR 7/4). |
| | | 10-18 | Saprolite, silty micaceous clay, yellowish-gray (10YR 8/1). |
| | | 18-30 | Saprolite, clayey sand, weak-yellowish-orange (10YR 7/3). |
| | A | 30-48 | Saprolite, clayey silty sand, light-brown (5YR 6/4). |
| | | 48-60 | Saprolite, sandy silty clay, moderate-reddish-brown (10R 4/6). |
| | | 60-70 | Saprolite, clayey sand, dark-yellow 5Y 6/6). |
| | | 70-90 | Saprolite, clayey micaceous sand, light-yellowish-gray (2.5Y 6/4). |
| | | 90 | Gneiss. |

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Auger Hole Logs (continued)

| Formation | | Sample depth (feet) | Description |
|---|---|---|---|
| | | | Auger hole 131; elev. 2,605 ft; sec. 9, T. 48 N., R. 5 W. |
| Palouse- - - - - - - - - | | 0-11 | Clayey silt. |
| Latah- - - - - - - - - - | A | 11-13 | Clayey sand, weak-yellow (2.5Y 7/2). |
| | B | 13-17 | Silty clay, weak-yellowish-orange (10YR 7/4). |
| Basalt - - - - - - | C | 17-19 | Saprolite, light-brownish-gray (10YR 6/1). |
| | D | 19-31 | Saprolite, light-bluish-gray (5B 6/1). |
| | E | 31-36 | Saprolite, light-yellowish-brown (10YR 6/4). |
| | F | 36-41 | Saprolite, light-olive-gray (5Y 6/1). |
| | G | 41-45 | Saprolite, greenish-gray (5GY 5/1). |
| | | | Auger hole 132; elev. 2,555 ft; sec. 16, T. 48 N., R. 5 W. |
| Palouse- - - - - - - - - | | 0-8 | Clayey silt. |
| Basalt - - - - - - - - - | | 8-22 | Saprolite, bluish-gray (5B 5/1). |
| | | 22-27 | Saprolite, olive-gray (5Y 4/1). |
| | | 27 | Rock. |
| | | | Auger hole 133; elev. 2,550 ft; sec. 17, T. 48 N., R. 5 W. |
| Palouse- - - - - - - - - | | 0-9 | Clayey silt. |
| Latah- - - - - - - - - - | | 9-10 | Sandy micaceous clay, weak-yellowish-orange (2.5Y 7/4). |
| Basalt - - - - - - - - - | | 10-13 | Saprolite, olive-gray (5Y 4/1). |
| | | 13 | Rock. |
| | | | Auger hole 134; elev. 2,665 ft; sec. 8, T. 48 N., R. 5 W. |
| Palouse- - - - - - - - - | | 0-10 | Clayey silt. |
| Latah- - - - - - - - - - | | 10-13 | Sandy clay, weak-yellowish-brown (2.5Y 7/4). |
| | | 13-15 | Clay, light-gray (N7), plastic. |
| Basalt - - - - - - - - - | | 15-16 | Saprolite, bluish-gray (5B 5/1). |
| | | 16-23 | Saprolite, olive-gray (5Y 3/1). |
| | | 23-24 | Saprolite, olive-black (5Y 2/1). |
| | | 24 | Rock. |

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Auger Hole Logs (continued)

| Formation | Sample depth (feet) | Description |
|---|---|---|
| **Auger hole 135; elev. 2,580 ft; sec. 8, T. 48 N., R. 5 W.** | | |
| Palouse- - - - - - - - - | 0-12 | Clayey silt. |
| | 12-15 | Sand and gravel. |
| Latah- - - - - - - - - - - | 15-25 | Clay, yellowish-gray (10YR 7/1), plastic. |
| Basalt - - - - - - - - - - | 25-30 | Saprolite, bluish-gray (5B 5/1). |
| | 30-34 | Saprolite, olive-black (5Y 2/1). |
| | 34 | Rock. |
| **Auger hole 136; elev. 2,615 ft; sec. 13, T. 48 N., R. 6 W.** | | |
| Latah- - - - - - - - - - - | 0-4 | Silty sand, weak-yellowish-orange (2.5Y 7/4). |
| | 4-8 | Silty sand, weak-yellow (5Y 7/2). |
| | A 8-11 | Silty sandy clay, reddish-gray (10R 6/1). |
| | 11-13 | Silty clay, weak-yellow (7.5Y 7/2). |
| | 13-20 | Clayey sand, dusky-yellow (5Y 6/3). |
| | 20-23 | Silty clay, light-brown (7.5 YR 6/4). |
| Basalt - - - - - - - - - | B 23-48 | Saprolite, brownish-gray (10YR 4/1). |
| Pre-Tertiary - - - - - - | C 48-60 | Saprolite, clayey silty sand, weak-yellow (2.5Y 7/2). |
| | 60-95 | Saprolite, micaceous clayey sand, light-olive-brown (2.5Y 5/4). |
| | 95 | Gneiss. |
| **Auger hole 137; elev. 2,600 ft; sec. 13, T. 48 N., R. 6 W.** | | |
| Pre-Tertiary - - - - - - - | 0-19 | Saprolite, clayey micaceous sand, light-olive-brown (2.5 Y 5/4). |
| | 19 | Gneiss. |
| **Auger hole 138; elev. 2,660 ft; sec. 13, T. 48 N., R. 6 W.** | | |
| Palouse- - - - - - - - - | 0-2 | Clayey silt. |
| Pre-Tertiary - - - - - - - | 2-33 | Saprolite, clayey micaceous sand, light-olive-brown (2.5Y 5/4). |
| | 33 | Gneiss. |

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Auger Hole Logs (continued)

| Formation | | Sample depth (feet) | Description |
|---|---|---|---|
| Auger hole 139; elev. 2,610 ft; sec. 17, T. 48 N., R. 5 W. | | | |
| Palouse- - - - - - - - | | 0-3 | Clayey silt. |
| | | 3-5 | Sand and gravel. |
| Latah- - - - - - - - - | | 5-8 | Clayey micaceous sand, light-brown (5YR 5/6). |
| | | 8-10 | Clayey micaceous sand, strong-yellowish-brown (10YR 5/8). |
| | A | 10-19 | Silty sandy clay, weak-yellowish-orange (2.5Y 8/4). |
| | B | 19-26 | Silty sandy clay, light-gray (N8). |
| Basalt - - - - - - - | C | 26-30 | Saprolite, white (N9), halloysite. |
| Pre-Tertiary - - - - | D | 30-40 | Saprolite, silty sandy clay, weak-yellow (5Y 8/2). |
| Auger hole 140; elev. 2,605 ft; sec. 20, T. 48 N., R. 5 W. | | | |
| Palouse- - - - - - - - | | 0-20 | Clayey silt. |
| Basalt - - - - - - - - | | 20-30 | Saprolite, moderate-yellowish-brown (10YR 4/4), halloysite nodules. |
| | | 30-50 | Saprolite, brownish-black (10YR 2/1), nontronite nodules. |
| | | 50 | Rock. |
| Auger hole 141; elev. 2,620 ft; sec. 20, T. 48 N., R. 5 W. | | | |
| Palouse- - - - - - - - | | 0-5 | Clayey silt. |
| Basalt - - - - - - - - | | 5-15 | Saprolite, bluish-gray (5B 5/1). |
| | | 15-30 | Saprolite, weak-brown (10YR 4/3). |
| | | 30-35 | Saprolite, weak-brown (2.5Y 4/2), halloysite nodules. |

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APPENDIX E.--Chemical composition, grain-size distribution, and clay minerals in select samples from auger holes

(Data from Hosterman, 1969, p. 92)

Chemical analysis by X-ray fluorescence method, in weight percent; Tr., Trace

| Sample | Unit | Sample thickness (feet) | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MnO | CaO | $K_2O$ | $TiO_2$ | Loss on ignition | Grain-size distribution (parts-in-10, by weight) | | | Clay mineral (parts-in-10 by weight) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Sand | Silt | Clay | Kaolinite | Halloysite | Illite | Montmorillonite | Non-trionite |
| 116A | Basalt saprolite | 12.0 | 48 | 36 | 1.7 | .07 | .3 | .3 | 3.2 | 11.8 | -- | 1.0 | 9.0 | -- | 10.0 | -- | -- | -- |
| 118A | Latah Formation | 6.0 | 54 | 21 | 1.2 | .01 | .2 | 1.6 | 1.2 | 7.3 | 3.5 | 2.4 | 4.0 | 7.0 | -- | 2.5 | -- | -- |
| 118B | do | 20.0 | 57 | 27 | 1.2 | .01 | .2 | 1.9 | 1.0 | 7.4 | 4.0 | 2.0 | 4.0 | 8.0 | -- | 2.0 | -- | -- |
| 118C | do | 20.0 | 62 | 23 | 1.0 | .02 | .2 | 3.0 | .6 | 5.2 | 6.0 | 2.0 | 2.0 | 8.0 | -- | 2.0 | -- | -- |
| 118D | do | 25.0 | 72 | 19 | .7 | .01 | .2 | 3.0 | .4 | 3.7 | 7.5 | 1.0 | 1.5 | 7.5 | -- | 2.5 | -- | -- |
| 118E | do | 15.0 | 53 | 21 | .6 | .01 | .5 | 2.5 | .7 | 30.9 | 3.0 | 3.0 | 4.0 | 5.5 | -- | 4.5 | -- | -- |
| 121A | Basalt saprolite | 17.0 | 48 | 28 | 3.5 | .02 | .4 | 1.0 | 1.6 | 12.0 | -- | .5 | 9.5 | -- | 8.0 | -- | -- | 2.0 |
| 129A | Basalt saprolite | 11.0 | 68 | 18 | 2.7 | .02 | .4 | .6 | .9 | 8.2 | -- | 3.0 | 7.0 | -- | 9.5 | -- | -- | .5 |
| 129B | do | 10.0 | 70 | 16 | 2.7 | .02 | .5 | .4 | .6 | 10.9 | -- | 1.0 | 9.0 | -- | 10.0 | -- | -- | -- |
| 130A | Pre-Tertiary saprolite | 18.0 | 54 | 20 | 9.2 | .22 | .2 | 1.0 | 1.3 | 7.6 | 4.0 | 3.5 | 2.5 | 5.5 | -- | 4.5 | -- | -- |
| 131A | Latah Formation | 2.0 | 57 | 22 | 4.2 | .06 | .4 | 1.6 | 1.1 | 3.5 | 5.5 | 1.5 | 3.0 | 9.5 | -- | .5 | -- | -- |
| 131B | do | 4.0 | 44 | 32 | 4.1 | .02 | .2 | .1 | 1.8 | 12.0 | 1.5 | 1.5 | 7.0 | 10.0 | -- | -- | -- | -- |
| 131C | Basalt saprolite | 2.0 | 47 | 30 | 2.7 | .02 | .4 | .4 | 2.2 | 13.4 | -- | 1.0 | 9.0 | 1.5 | 8.5 | -- | -- | -- |
| 131D | do | 12.0 | 36 | 30 | 4.6 | .06 | .3 | .1 | 9.5 | 12.6 | -- | 3.0 | 7.0 | -- | 10.0 | -- | -- | -- |
| 131E | do | 5.0 | 32 | 17 | 31 | .07 | .6 | .2 | 5.5 | 11.7 | -- | 4.0 | 6.0 | -- | 10.0 | -- | -- | -- |
| 131F | do | 5.0 | 40 | 20 | 18 | .13 | 2.8 | .3 | 6.0 | 9.4 | -- | 4.0 | 6.0 | -- | 9.0 | -- | -- | 1.0 |
| 131G | do | 4.0 | 48 | 14 | 13 | .09 | 5.8 | .5 | 5.1 | 4.3 | -- | 4.0 | 6.0 | -- | -- | -- | -- | 10.0 |
| 136A | Latah Formation | 3.0 | 55 | 27 | .7 | .01 | .2 | 1.9 | 1.3 | 8.6 | 3.5 | 3.0 | 3.5 | 9.5 | -- | -- | .5 | -- |
| 136B | Basalt Saprolite | 25.0 | 44 | 17 | 22 | .31 | .8 | .5 | 4.8 | 10.8 | -- | 3.5 | 6.5 | -- | 3.5 | -- | -- | 6.5 |
| 136C | Pre-Tertiary saprolite | 12.0 | 56 | 19 | 18 | .12 | .4 | 2.6 | 1.6 | 6.5 | 5.0 | 3.0 | 2.0 | 3.0 | -- | 5.5 | 1.5 | -- |
| 139A | Latah Formation | 9.0 | 49 | 28 | 3.7 | .02 | .2 | .8 | 1.1 | 9.0 | 3.0 | 2.5 | 4.5 | 9.5 | -- | .5 | -- | -- |
| 139B | do | 7.0 | 50 | 37 | .5 | .01 | .2 | .7 | .9 | 11.0 | 3.0 | 3.0 | 4.0 | 9.5 | -- | .5 | -- | -- |
| 139C | Basalt saprolite | 4.0 | 46 | 38 | .4 | .01 | .2 | .2 | 1.6 | 14.6 | -- | .5 | 9.5 | -- | 10.0 | | -- | -- |
| 139D | Pre-Tertiary saprolite | 10.0 | 54 | 29 | 1.7 | .02 | .2 | .9 | 1.1 | 9.2 | 3.5 | 2.5 | 4.0 | 9.0 | -- | .5 | .5 | -- |

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Table 1.--Precious and base metal deposits in the Purcell Mountains, Idaho 1/

| Mine or prospect | Location | Deposit type | Host rocks | Mineral values | Development | Production | Other | References |
|---|---|---|---|---|---|---|---|---|
| Golden Sceptre mine | NE1/4 sec. 14, T. 65 N., R. 1 W.* | Three quartz-calcite veins; N. 10° W., 35° E., approximately 3 feet thick; N. 70° W., 85° NE., 20 feet thick; N. 35 W., 80° SW., about 5 feet thick | Precambrian mafic sill and quartzite | Gold, copper, zinc, lead, thorium, uranium | 2 adits, about 4000 feet of development | None | See energy minerals section and table 2 | (Kiilsgaard, 1949, p. 31) (Lemoine, 1959, p. 48 - 64) (____ 1960, p. 15-22) (USGS Copeland quad.) |
| Trust mine | SW1/4 sec. 19, T. 65 N., R. 1 E. | Quartz and calcite vein, 2-6 feet thick, N. 7° to 15° W., 35° to 40° E. | Precambrian mafic sill and quartzite | Gold, silver, copper | Several adits on 3 levels | None | Select sample assayed 0.06 oz/t Au, 5.4 oz/t Ag | (Kirkham and Ellis, 1926, p. 66) (USGS Hall Mountain quad.) |
| Montgomery mine | Center sec. 30, T. 65 N., R. 1 E. | Quartz vein approximately N. 20° W. 30° NE., 10 inches to 5 feet thick | Precambrian mafic sill and quartzite | Silver, lead, zinc, nickel | 7 adits totaling 3200 feet | None | Core drilled, with assays up to 3.5% Cu and 1.1% Ni | (Kiilsgaard, 1949, p. 25) (USGS Copeland quad.) |
| Miller Brothers mine | South center sec. 26, T. 65 N., R. 1 E.* | Quartz vein N. 5° E., 22° E, 1 foot thick | Precambrian mafic sill and quartzite | Lead, zinc, silver, copper | Open cuts, 200-foot inclined shaft | Possibly lead, silver in the 1930's. | | (Brackebusch, 1969, p. 63) (Kiilsgaard, 1949, p. 31) (USGS Hall Mountain quad.) |

1/ See figure 2.

* USGS Topographic map location used because of conflicting locations given in references.

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Table 1.--Precious and base metal deposits in the Purcell Mountains, Idaho 1/ (cont.)

| Mine or prospect | Location | Deposit type | Host rocks | Mineral values | Development | Production | Other | References |
|---|---|---|---|---|---|---|---|---|
| Kent mine | NE1/4 sec. 9, T. 64 N., R. 1 E. | Quartz vein E.-W. 80° N. | Precambrian quartzite and granite | Lead, zinc, molybdenum | 110 foot shaft | None | | (Kirkham and Ellis, 1926, p. 67-68) (Livingston, 1919, p. 40) (USGS Hall Mountain quad.) |
| American Girl mine | NE1/4 sec. 9 and NW1/4 sec. 10, T. 64 N., R. 1 E. | Quartz vein N. 42° E., 69° SE., 4 inches to 8 feet thick. Pegmatite dike | Precambrian quartzite and granite | Copper, lead, zinc, molybdenum | 2200 feet of development by adits, cross-cuts, and drifts | None | | (Kiilsgaard, 1949, p. 25) (Kirkham and Ellis, 1926, p. 60) (USGS Hall Mountain quad.) |
| Bethlehem mine (Dora tunnel) | SW1/4 sec. 14, T. 64 N., R. 1 E. | Quartz vein N. 61° E., 70° SE., several inches to 2 feet thick | Precambrian mafic sill, quartzite and granite | Lead, zinc, copper | 4 adits, shaft, 350 feet of development | None | Lowest adit averages $5-$10 in all metals | (Kiilsgaard, 1949, p. 28) (Brackebusch, 1969, p. 62) (Kirkham and Ellis, 1926, p. 68). (USGS Hall Mountain quad.) |
| Tungsten Hill mine (M&F property) | Center sec. 13, T. 64 N., R. 1 E. | Quartz vein N. 84° W., 70° N., 7-8 feet thick | Diorite | Tungsten, lead, copper | 500 feet of adits and surface cuts | 816 pounds $WO_3$ | Five samples totaling 27.5 ft. averaged 1.09% $WO_3$ | (Kirkham and Ellis, 1926, p. 60) (Brackebusch, 1969, p. 68-69) (Livingston, 1919, p. 11-15) (USGS Hall Mountain quad.) |

1/ See figure 2.

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Table 1.--Precious and base metal deposits in the Purcell Mountains, Idaho 1/ (cont.)

| Mine or prospect | Location | Deposit type | Host rocks | Mineral values | Development | Production | Other | References |
|---|---|---|---|---|---|---|---|---|
| Queen mine | SE1/4 sec. 8, T. 64 N., R. 2 E. | Quartz veins less than 5 feet thick | Precambrian mafic sill and quartzite | Gold, silver, lead, zinc, copper | Adits, crosscuts, and inclined | None | | (Kiilsgaard, 1949, p. 18) (Brackebusch, 1969, p. 64) (USGS Eastport quad.) |
| Tilley mine | Center sec. 9, T. 64 N., R. 2 E. | Quartz veins in shear N-S 45° E. | Prichard Formation | Lead-zinc | Over 2000 feet, developed by 3 adits | None | | (Brackebusch, 1967, p. 66-67) (USGS Eastport quad.) |
| Tommy Moran prospect | Sec. 18 or 19, T. 64 N., R. 2 E. | Quartz veins | Granite | Gold, silver, lead, copper | Open cuts and small shafts | None | | (Kiilsgaard, 1949, p. 32) (Brackebusch, 1969, p. 68) (Kirkham and Ellis, 1926, p. 60) (USGS Eastport quad.) |
| Buckskin prospect | Sec. 30, T. 64 N., R. 2 E. | Quartz vein N. 70° E., 48° SE., 30 inches thick | Granite | Gold, silver, lead | Open cuts and 2 short crosscut adits | None | | (Kiilsgaard, 1949, p. 32) (USGS Ritz quad.) |
| Klondike mine | Sec. 29, T. 64 N., R. 1 E. | Quartz vein, N. 54° E., 75° SE., 18 to 30 inches thick | Granodiorite | Lead, zinc, silver | Several open cuts and an 800-foot adit | None | Select sample assayed 72% Pb, 70 oz/t Ag, Tr Au | (Kiilsgaard, 1949, p. 28) (USGS Meadow Creek quad.) |

1/ See figure 2.

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Table 1.--Precious and base metal deposits in the Purcell Mountains, Idaho 1/ (cont.)

| Mine or prospect | Location | Deposit type | Host rocks | Mineral values | Development | Production | Other | References |
|---|---|---|---|---|---|---|---|---|
| Regal mine (Silver Crescent) | SW1/4 sec. 31, T. 64 N., R. 2 E. | Quartz veins, average N. 65° E., 55° SE. | Cretaceous granite | Lead, zinc, silver, gold | 3800 feet of drifts, crosscuts, and adits on 3 levels | Significant | Mill feed averaged 3% Pb, 3.5% Zn, 3 oz/t Ag, 0.12 to 0.2 oz/t Au | (Anderson and Wagner, 1945, p. 6-9) (Brackebusch, 1969, p. 65) (USGS Hall Mountain quad.) |
| Arsenopyrite vein | NW1/4 sec. 31, T. 62 N., R. 2 E. | Quartz vein, N. 50° W., 55° SW., several feet to 14 feet thick | Precambrian mafic sill | Arsenic | None | None | Vein assayed 0.5% arsenic | (Kirkham and Ellis, 1926, p. 63-64) (USGS Bonners Ferry quad.) |

1/ See figure 2.

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Table 2. - Thorium and uranium occurrences, Hall Mountain and Kootenai River Valley, Idaho 1/

| Mine or prospect | Location | Deposit type and orientation | Host rocks | Mineral values | Development | Sample data | References |
|---|---|---|---|---|---|---|---|
| Golden Sceptre | NE1/4 sec. 14, T. 65 N., R. 1 W. | Quartz-calcite vein; N. 35° W., 80° NE., 540 ft. long, 0.5-5 ft. thick | Precambrian mafic sill and quartzite | Thorium, gold, copper, lead, zinc | 4000 ft. development by 2 adits | 4 chip samples total 5.7 ft., assayed 1.19% thorium | (LeMoine, 1960, p. 19) (Staatz, 1972a, p. 243, 245, 247) |
| Barringer property | NW1/4 sec. 13, T. 65 N., R. 1 W. | Irregular breccia shear zone, N 21° W. steep dip, 67 ft. long, 4-9 ft. thick | Precambrian quartzite | Thorium | 25 ft. adit | 9 ft. chip across brecia, 3.89% thorium | (LeMoine, 1960, p. 20-21) (Staatz, 1972a, p. 243, 245, 247) |
| Thorite vein | NE1/4 sec. 14, T. 65 N., R. 1 W. | N. 22° E., 35°-62° E., 700 ft. long, 0.6-10.8 ft. thick | Precambrian diorite sill | Thorium | Trench and 2 diamond drill holes | 2 ft. select assayed 21% thorium, 6 chip/channel samples, total 29 ft., assayed 2.9% thorium. Rare mineral cenosite | (LeMoine, 1960, p. 19-20) (Staatz, 1972a, p. 243, 245, 247) (Adams, and others, 1964, p. 1737) |
| Scheller prospect | SW1/4 sec. 13, T. 65 N., R. 1 W. | Vein; N. 30° W., 60° NE., N. 2° E., no data on dip | Precambrian quartzite | Thorium | Bulldozer trench and diamond drill hole | 11 ft. chip 0.0095% thorium, 1.2 ft. chip 0.022% thorium | (LeMoine, 1960, p. 18-19) (Staatz, 1972a, p. 243, 245, 247) |
| "U" group | Secs. 5, 6, 7, and 8, T. 64 N., R. 1 W. | Unknown | Pegmatite schist, granite | Uranium | Small pits and trenches | 0.16% $eU_3O_8$ | (Barlow and Hetland, 1955, p. 1) |
| Dehlbom prospect | SE1/4 NW1/4 sec. 14, T. 62 N., R. 1 W. | N. 70° E., 15° N., 0.5 ft. thick | Precambrian schist, Cretaceous pegmatite | Uranium | None? | Very low grade | (Powers, 1956) |
| Naples prospect | Center sec. 21, T. 60 N., R. 1 E. | Unknown | Cretaceous monzonite with pyrrhotite | Uranium | None? | Possibly uranium mineral gummite and autunite | (Weis and others, 1958, p. 16-17) (Cook, 1955, p. 14) (Armstrong, 1953, p. 220) (Hart, 1953, p. 1) |

1/ See figure 6.

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Table 4.--Tested clay deposits, Coeur d'Alene Indian Reservation area[1/]

| Site | Location | Deposit description | Uses | Reference (Steels, 1920) |
|---|---|---|---|---|
| 1 | East end Chicago, Milwaukee, St. Paul & Pacific (CMS&P) railroad cut, one-quarter mile east of St. Maries station | 19-foot-thick yellow and white clay. Well stratified; runs east-west, overburden 2 feet | Common brick drain tile, face brick, and structural wares | p. 24-25 |
| 2 | East end CMS&P railroad cut, 6 miles west of St. Maries | 8-foot-thick white clay over 8-foot-thick yellow clay, well stratified; deposit strikes north-south; 1-foot overburden | Crude pottery, stoneware, or terra cotta, and face brick | p. 25-26 |
| 3 | CMS&P railroad cut, 8 miles west of St. Maries | 20-foot-thick pink clay exposed for 100 feet in cut, beneath steeply dipping bed of quartzite | Face and common brick, and drain tile | p. 26-27 |
| 4 | East end of CMS&P cut, 2 miles west of St. Maries | 19-foot bed exposed for 100 feet along cut; gray, red, and yellow clay, strikes east to west; well stratified | Common and face brick, drain and roofing tile, and sewer pipe | p. 28 |
| 5 | Union Pacific Railway cut, one-quarter mile south of the Chatcolet station | 30-foot bed of yellow clay with red streaks, strikes north-south, overlain by 20-foot-thick bed of soft, sandy shale, 5 feet overburden | Common and face brick, drain tile | p. 36-37 |

1/ See figure 10.

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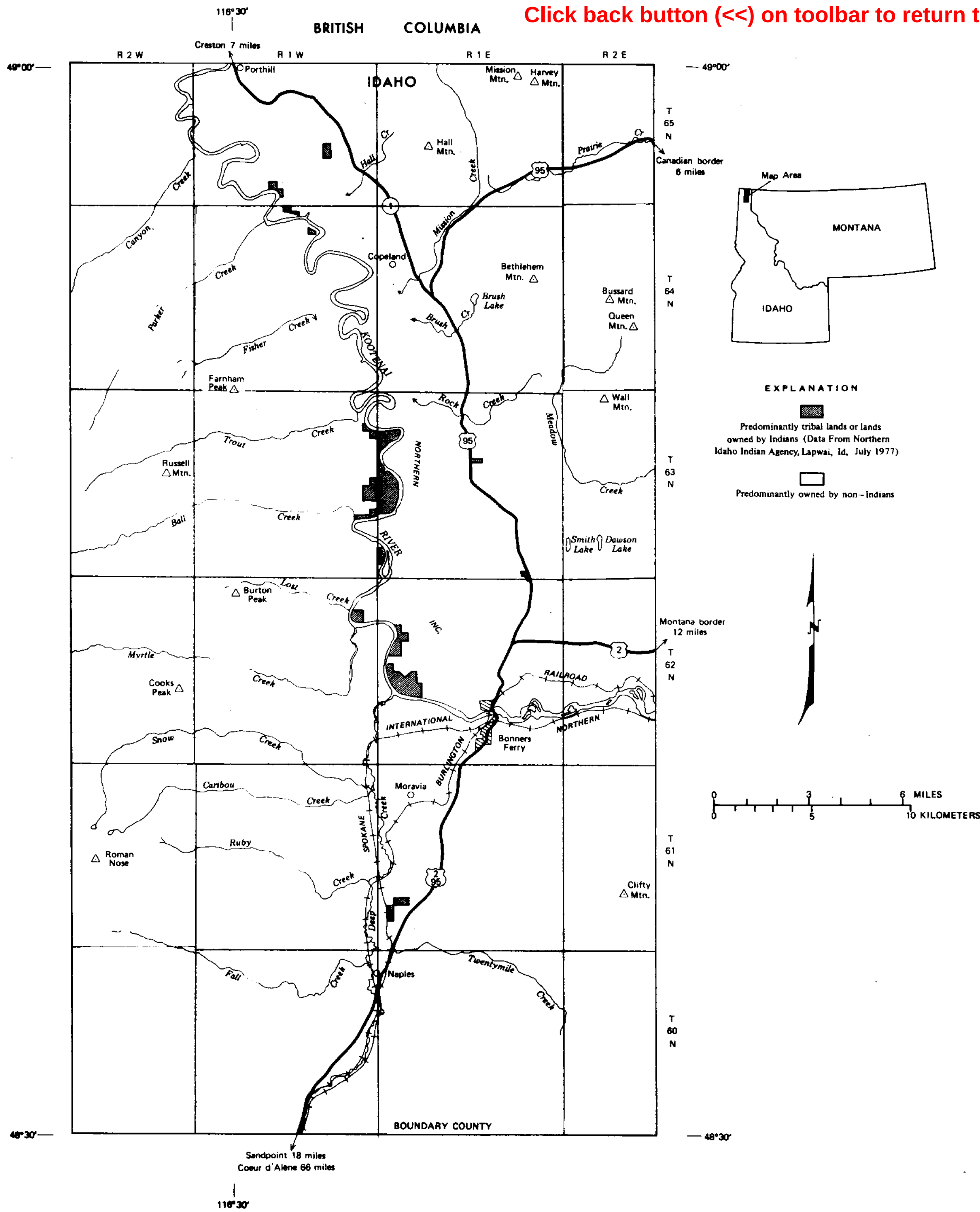


**Figure 1.** Index and land ownership map of the Kootenai Indian Reservation, Idaho.

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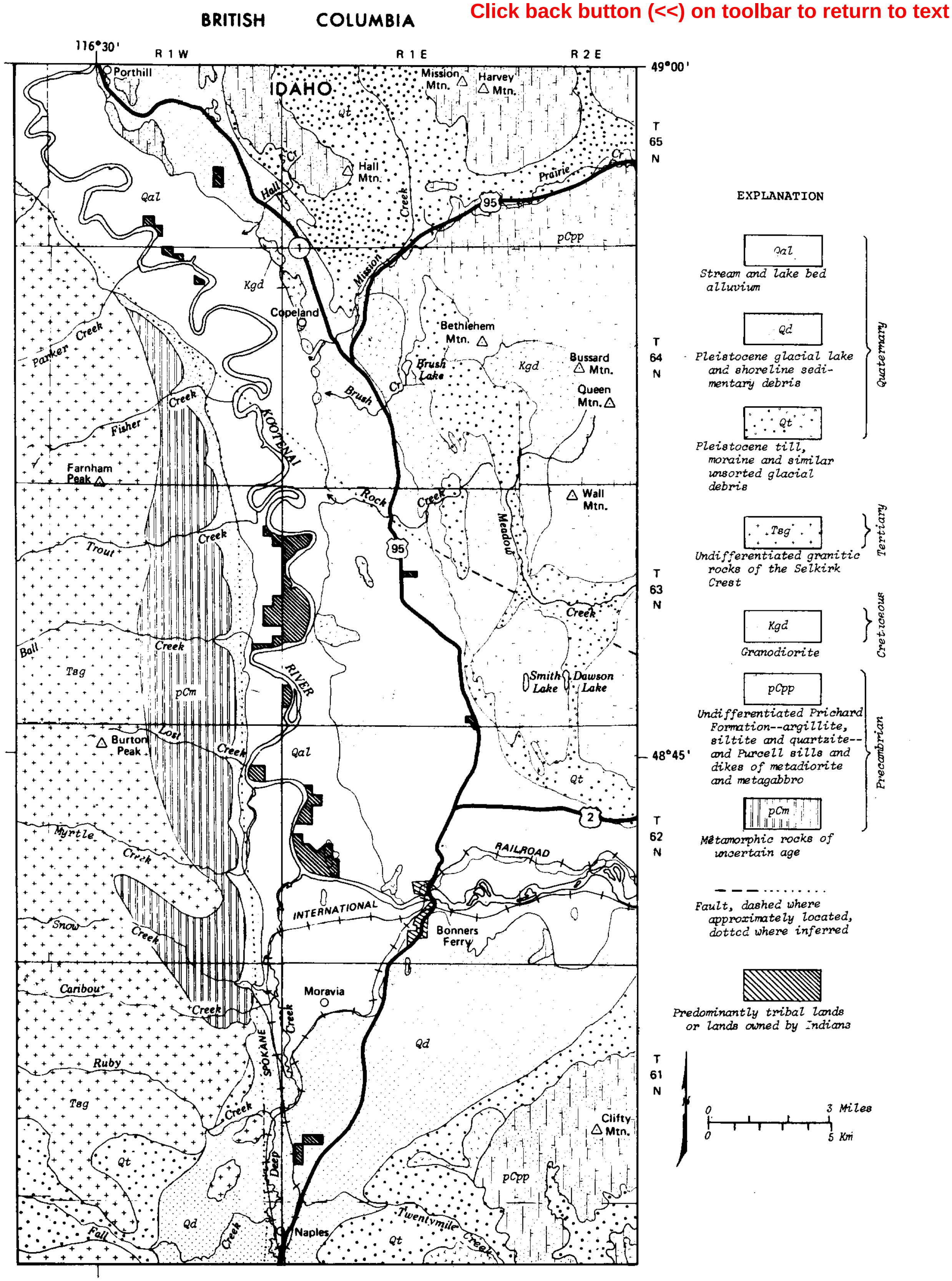


**Figure 2.** Geologic map of part of Boundary County, Idaho, which includes the Kootenai Indian Reservation.

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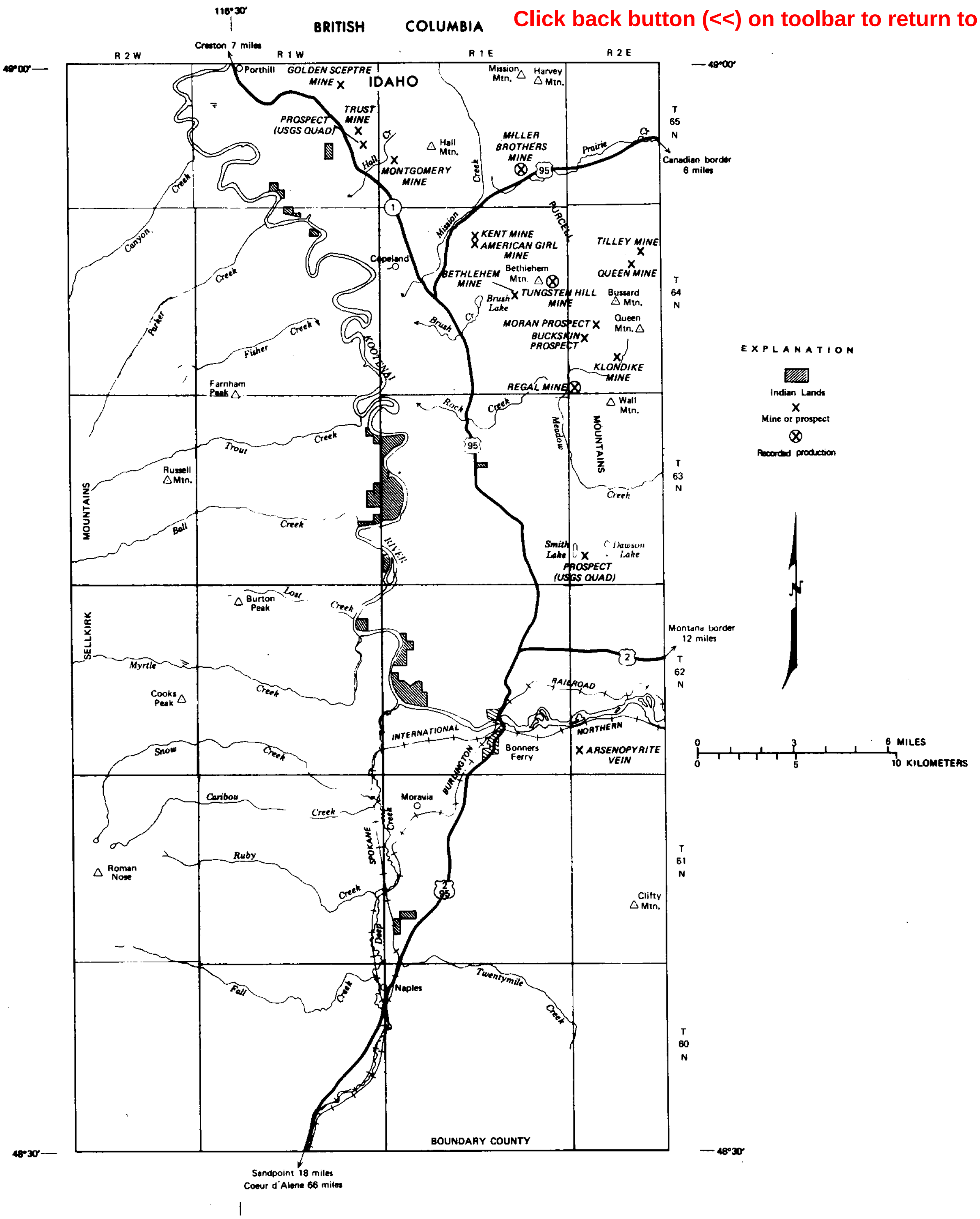


**Figure 3.** Base and precious metal mines and prospects near the Kootenai Indian Reservation.

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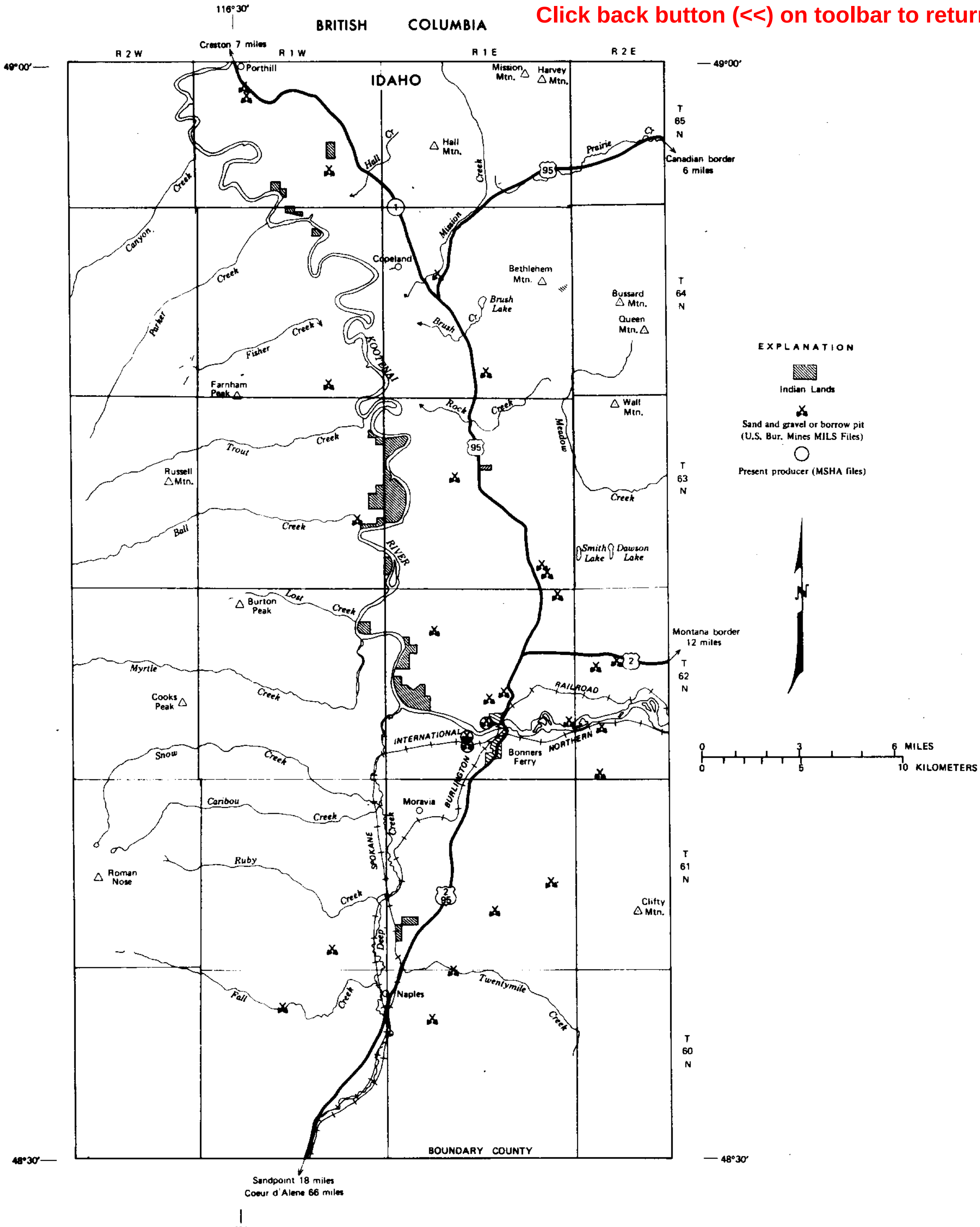


**Figure 4.** Sand and gravel and borrow pit locations near the Kootenai Indian Reservation, Idaho.

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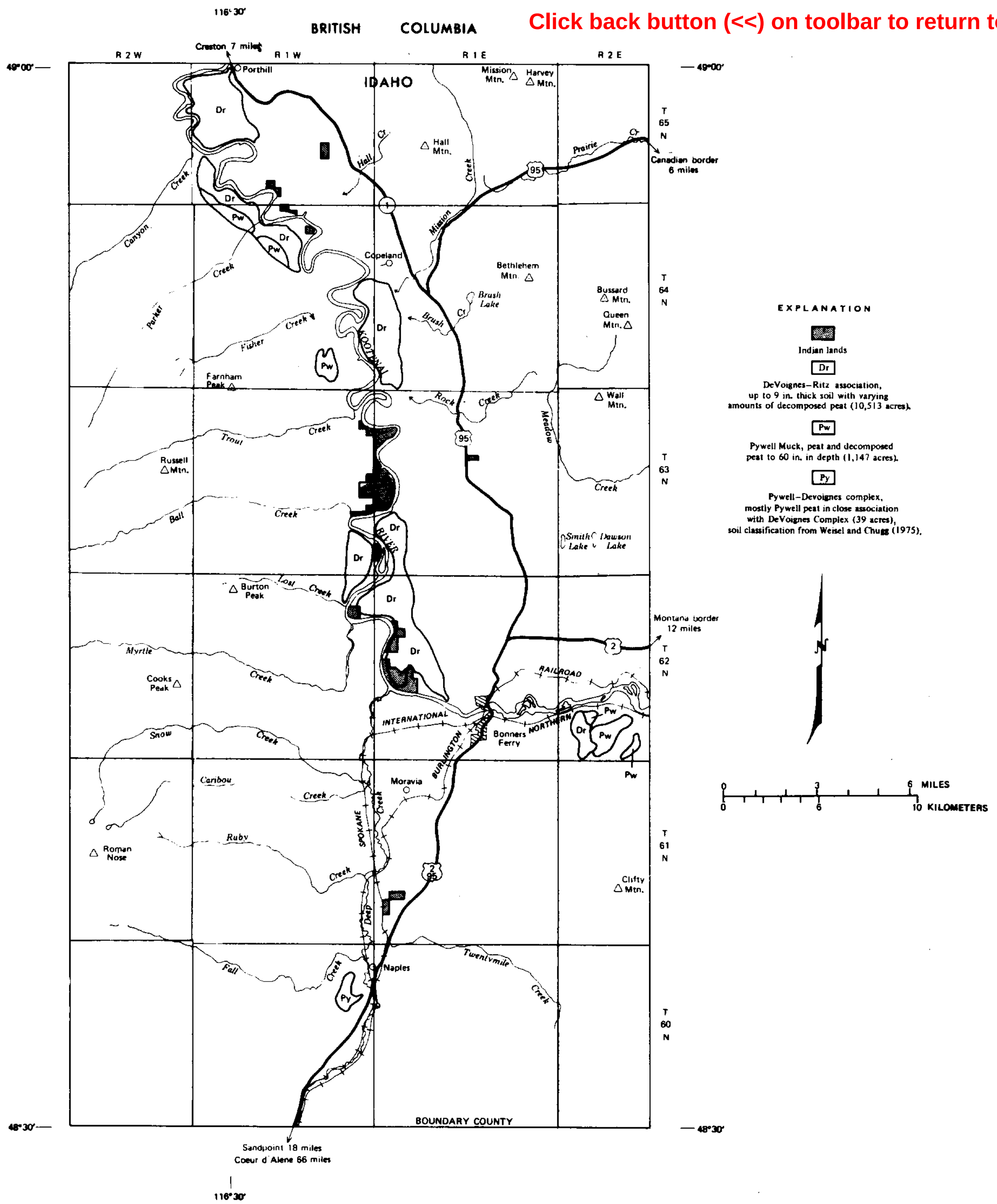


**Figure 5.** Soil map showing potential peat areas in the Kootenai River Valley, Idaho.

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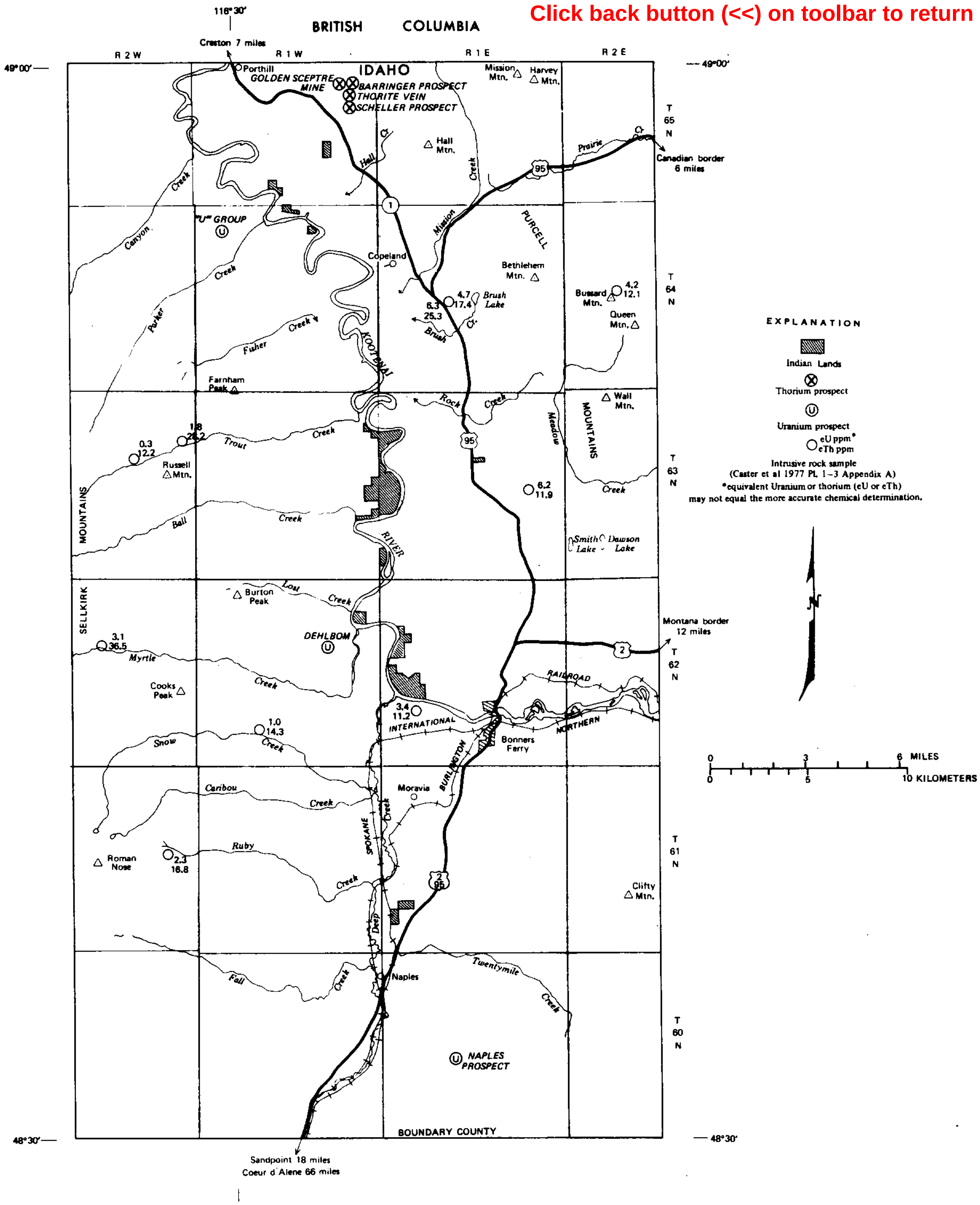


**Figure 6.** Thorium and uranium prospects and intrusive rock sample locations near the Kootenai Indian Reservation, Idaho.

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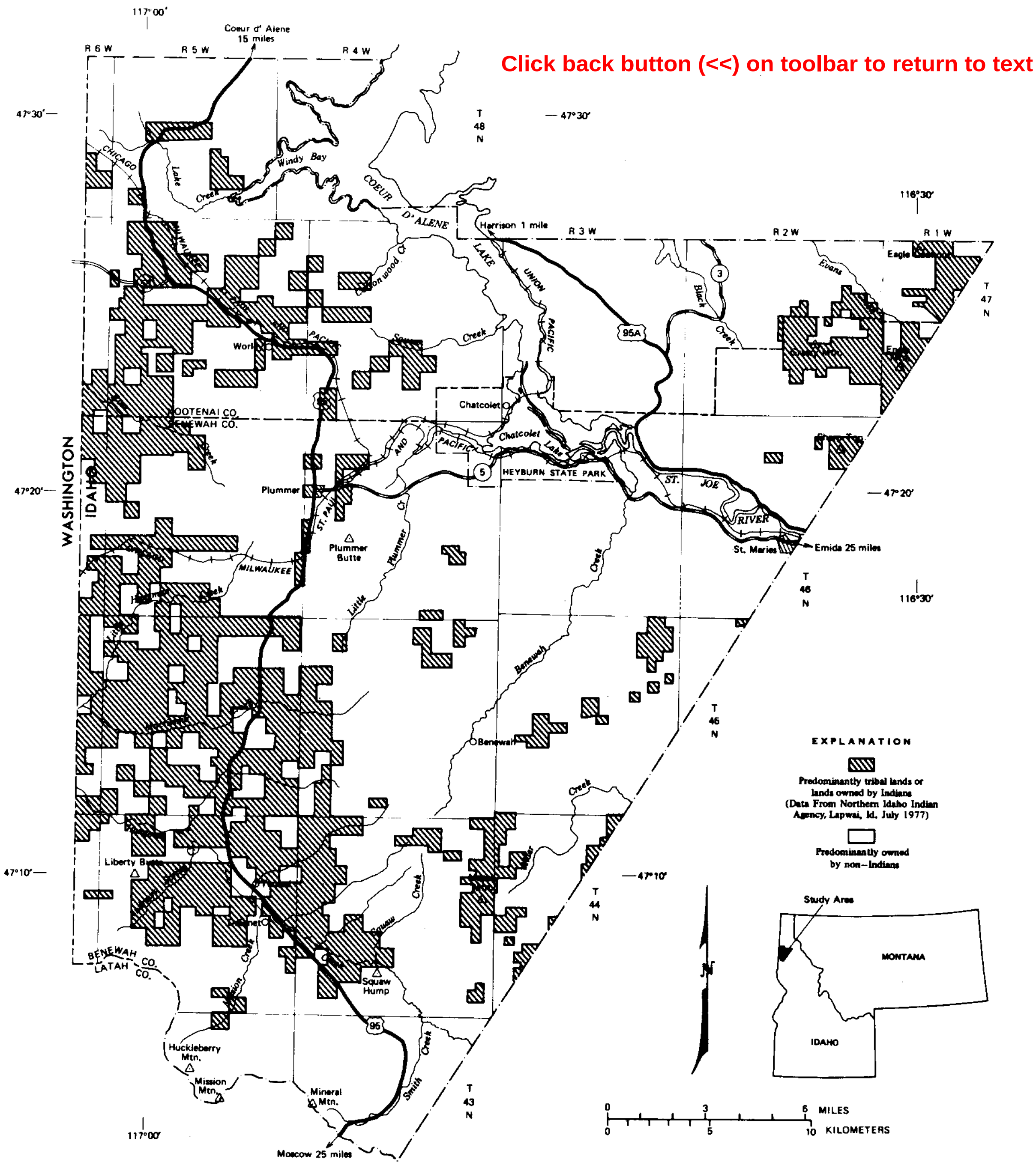


**Figure 7.** Index and generalized land ownership of the Coeur d'Alene Indian Reservation, Idaho.

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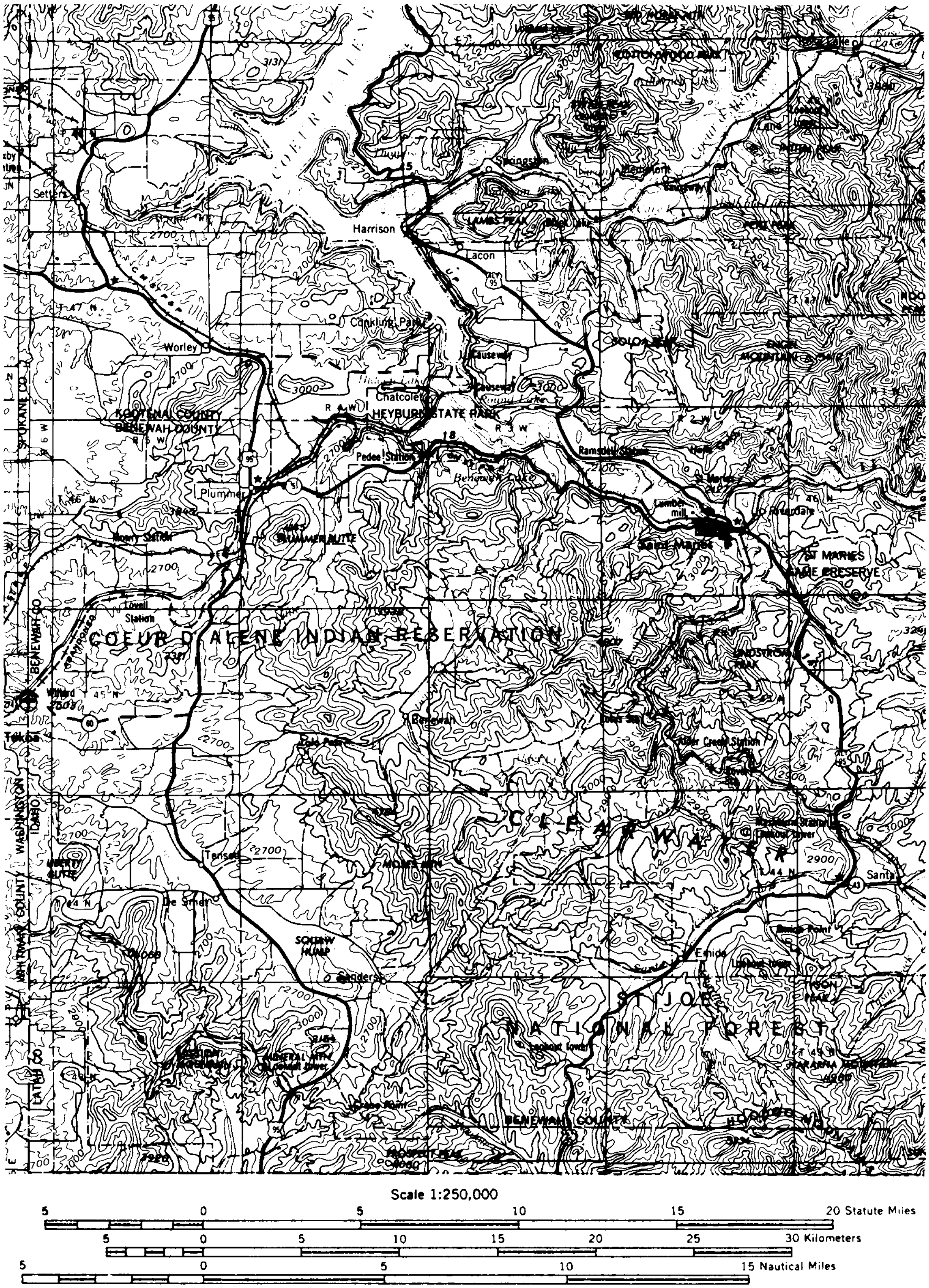


**Figure 8.** Topographic map, Coeur d'Alene Indian Reservation, Idaho.

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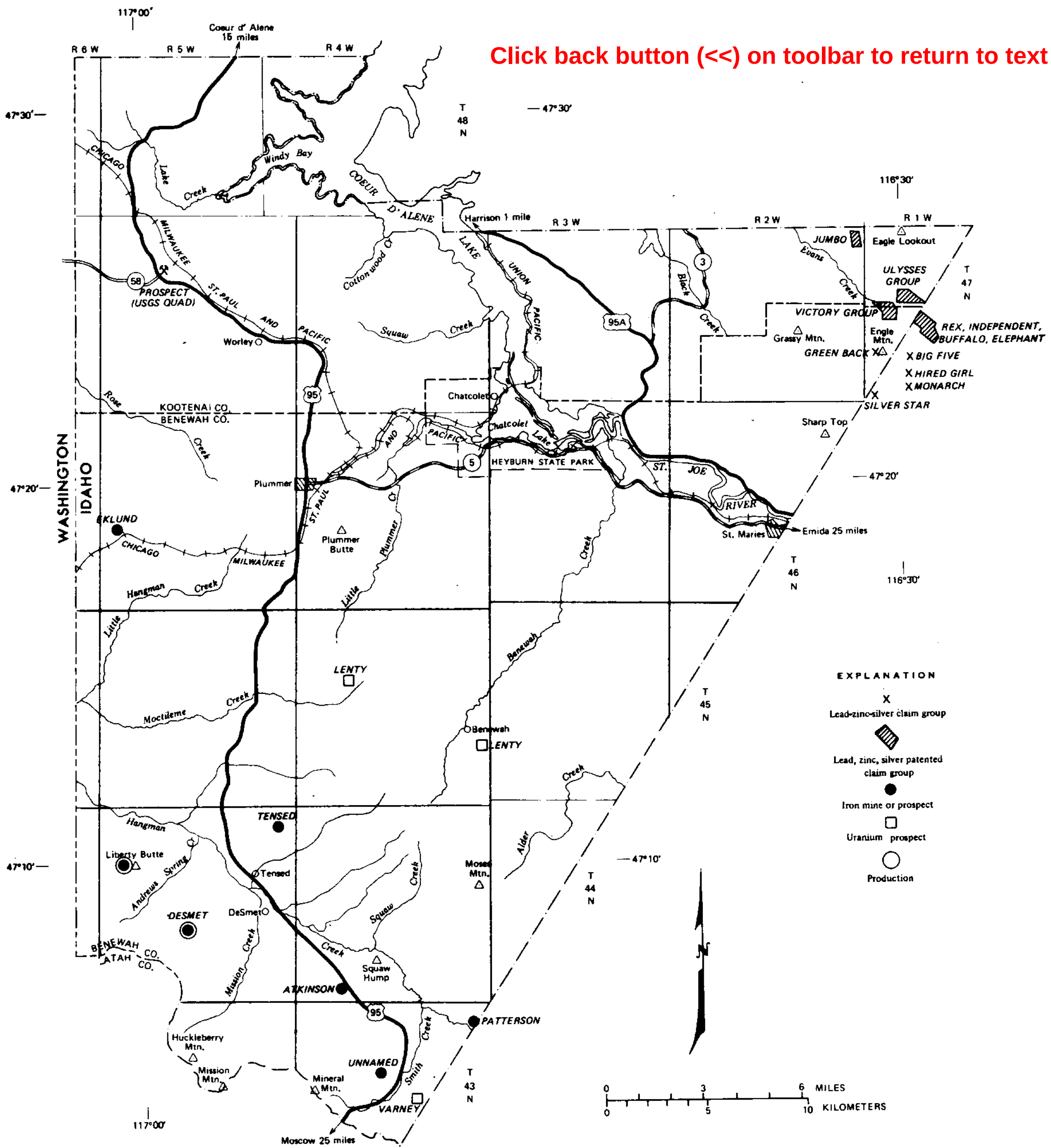


**Figure 9.** Lead, zinc, silver, iron, and uranium mines and prospects, and patented mining claims, Coeur d'Alene Indian Reservation, Idaho.

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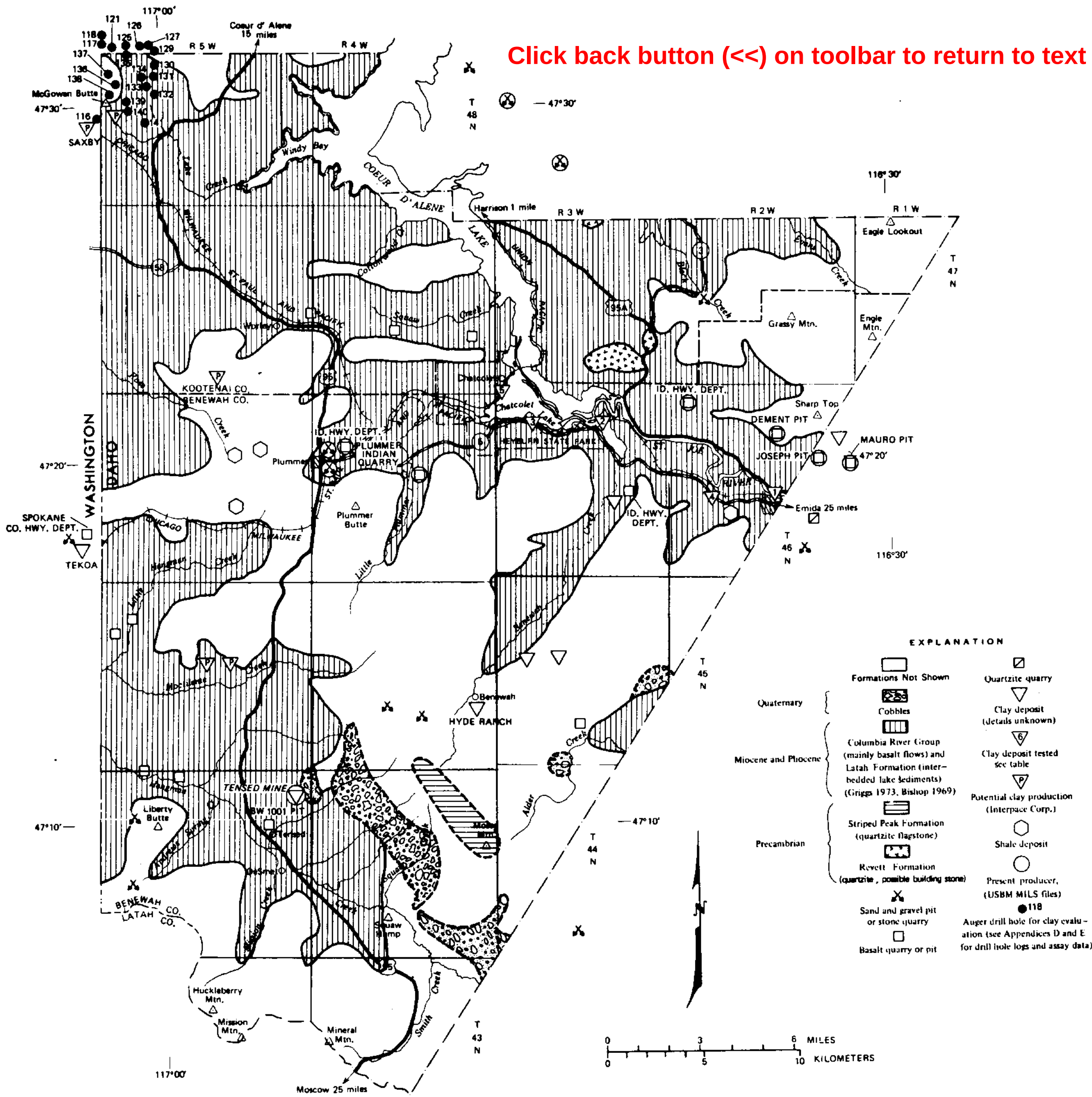


**Figure 10.** Generalized geologic map showing Columbia River basalt, quartzite, flagstone, cobbles, sand and gravel, clay, shale, and producing mines, Coeur d'Alene Indian Reservation, Idaho.

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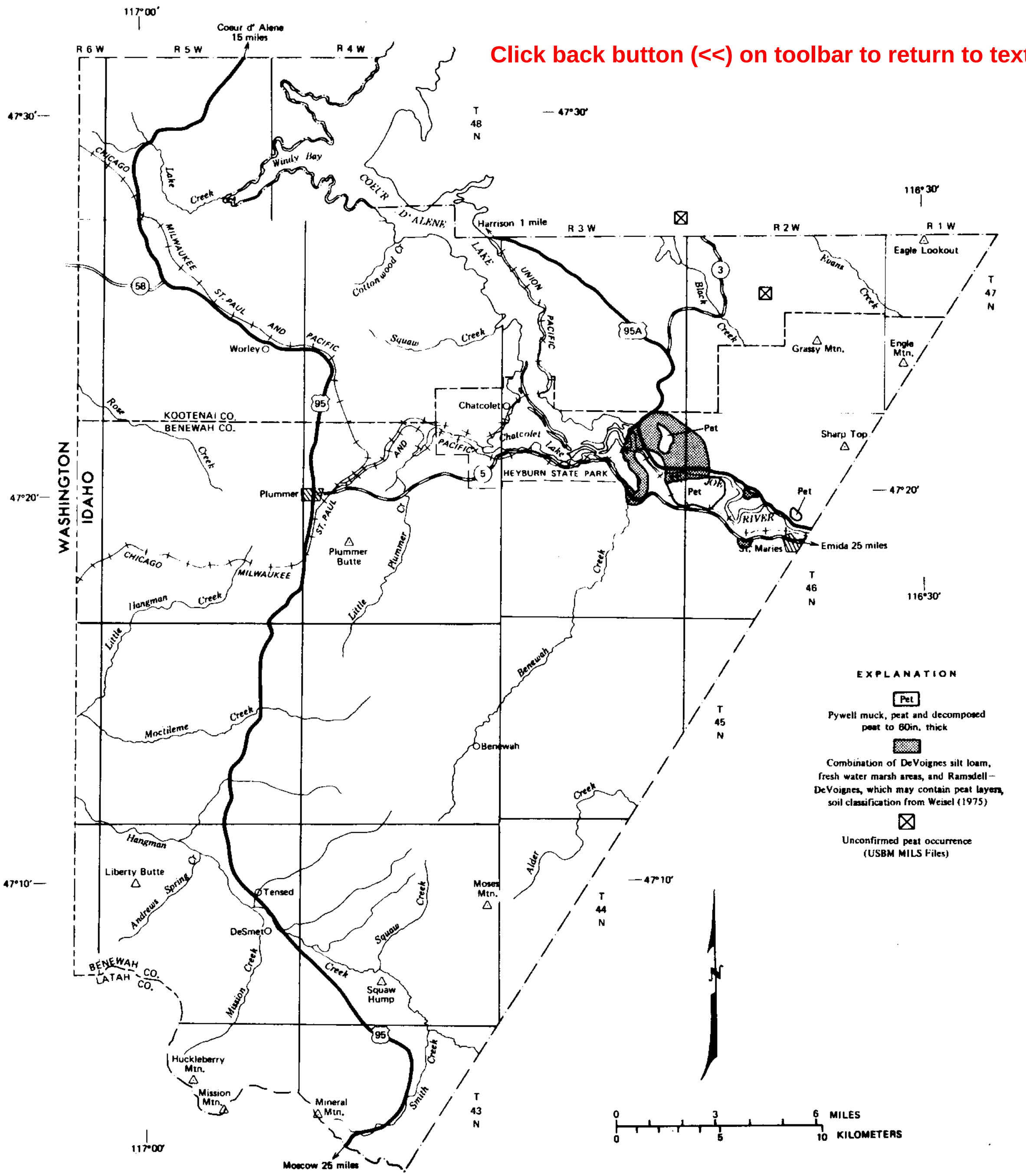


**Figure 11.** Generalized soil map showing potential peat areas, Coeur d'Alene Indian Reservation, Idaho.